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DAS Data Requirement 11

Acceptance Test Plan and Procedures for the Demand Access System (DAS)

Volume I: Verification Plan

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PREFACE

DRL-11 is divided into 2 volumes as indicated below:

Volume I: System Verification Plan
Volume II: System Test Procedures.

This document herein is Volume I. Appendix A (Verification Planning Table) to Volume I is provided under a separate cover.

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1. INTRODUCTION

1.1 OBJECTIVE

The Acceptance Test Plan and Procedures Document (DRL-11) provides for the Demand Access System (DAS) program, a detailed approach for accomplishing:

- Phase I: System Qualification
- Phase II: Factory acceptance testing (FAT)
- Phase III: Site acceptance testing (SAT).

Informal subsystem, or Critical Item (CI), and system engineering integration and test (I&T) are also conducted as shown in Exhibit 1.1-1, but are not part of the formal verification program:

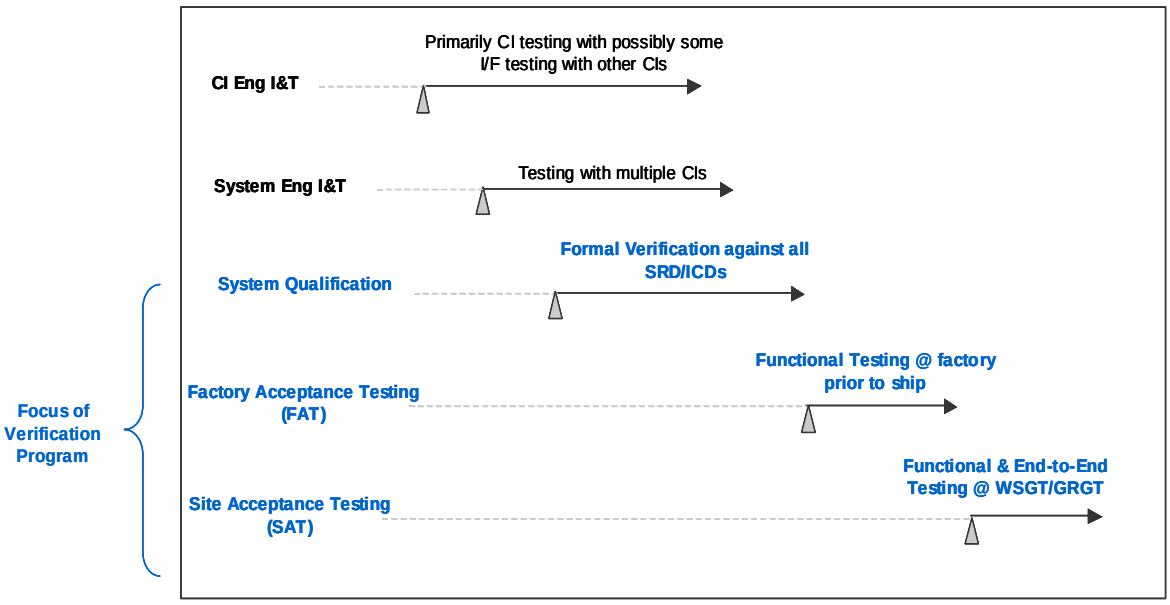

Exhibit 1.1-1: Test and Verification Overview

DRL-11 is divided into two volumes with this document being Volume I:

- Volume I focuses on the overall DAS verification plan without providing detailed test procedures. Volume I details the verification approach, schedule, resources, and documentation necessary to confirm that the DAS is designed, built, delivered and installed in accordance with the DAS Systems Requirements Document (453-SRD-DAS - [1]). It provides planning for all three verification phases.
- Volume II describes the detailed test procedures that are used to implement and conduct testing for all three verification phases.

1.2 SCOPE

This verification plan (Volume I) provides the plan for all three phases of DAS formal verification:

- Phase I: System Qualification
- Phase II: Factory Acceptance Testing
- Phase III: Site Acceptance Testing.

The scope of this verification includes all subsystems comprising the DAS system as described in Section 2.5 of this document, the internal interfaces between these subsystems, and the external system interfaces to DAS. These external interfaces are specified in three external ICDs ([2], [3], [4]):

- The WSC (White Sands Complex) equipment
- The Space Network Web-based Services Interface (SWSI)
- The NASA Integrated Services Network (NISN) IP Operational Network (IOnet).

This document defines the tests, demonstrations, analyses, and inspections that will verify that the DAS system complies with the product requirements at the system level. The plan includes the process for regression testing. A schedule for tests and demonstrations is provided.

1.3 APPLICABLE DOCUMENTS

The following documents are part of this plan to the extent cited herein. The most recent version of these documents takes precedence. If no section number is shown, the whole document applies.

1. 453-SRD-DAS, “Demand Access System (DAS) Systems Requirements Document.”
2. 453-ICD-DAS/WSC, “Interface Control Document between the Demand Access System and the White Sands Complex.”
3. 453-ICD-DAS/Customer, “Interface Control Document between the Demand Access System and the Demand Access System Customers.”
4. 453-ICD-DAS/SWSI, “Interface Control Document between the Demand Access System and the Space Network Web Services Interface”.
5. “DAS Performance Verification Matrix (PVM),” ITT Doc. No. 024-600007.
6. QM-01 "ITT-CSI Product Development Lab Quality Manual."
7. ITT Operating Procedure no. OP-05-02, "Document Control."
8. ITT Operating Procedure no. OP-05-04, "Engineering Change Form (ECF) Procedure."
9. ITT Operating Procedure no. OP-11-01, "Control of Inspection, Measuring, and Test Equipment (IM&TE)."
10. ITT Operating Procedure No. OP-14-01, "Corrective and Preventive Action."
11. ITT Operating Procedure No. OP-14-03, "Correction and Prevention of Software Problems."

12. ITT Operating Form No. OF-14-01, "Corrective Action Request (CAR)."
13. ITT Operating Form No. OF-14-03, "Software Problem Report (SPR)," Configuration Management Work Instruction No. CMWI-004, CCA Drawing Package Release & Change Control" 035-140826, “EDM Failure Analysis,” ITT. (Reston, VA) 30 September 1998.
14. ITT Configuration Management Work Instruction no. CMWI-004, CCA Drawing Package Release & Change Control"—Guidelines for the release and subsequent change control of CCA Technical Data Packages (TDPs).

2. VERIFICATION PROCESS

2.1 OVERVIEW

Section 2 describes the DAS verification process. The section identifies the verification phases, structure, methods, requirements traceability, test article definition, personnel roles and responsibilities, test locations and schedules.

2.2 OVERVIEW OF VERIFICATION PHASES

Section 2.2 overviews the verification phases noted previously in Exhibit 1.1-1. The elements of the Verification Plan elements that are unique for each phase are individually detailed in separate sections of this document:

- Section 3: System Qualification
- Section 4: FAT
- Section 5: SAT.

2.2.1 Pre-Verification Phase

Prior to formal verification, individual CI Engineering I&T is performed wherein each CI culminates with informal CI verification overseen by DAS System Engineering and Program Management. These verified CIs are then integrated into and tested at the system level as part of System Level I&T at the ITT factory in Reston, VA. During this period, there will be on-going engineering testing of groups of two or more CIs, along with emulators that support external I/F testing.

Pre-Verification testing of DAS will occur throughout the summer/fall timeframe of 2001 as individual CIs are completed and delivered for system-level integration.

2.2.2 Phase I Verification (System Qualification)

The first formal DAS Verification phase, referred to as 'System Qualification', verifies that DAS meets all SRD requirements except for those allocated only to SWSI. System Qualification will be accomplished as per the PVM using a combination of analysis, inspection, demonstration (demo) and testing. DAS must interface and interact with several components that are external to ITT's DAS equipment (e.g., ECON, CTFS SSC, SWSI, etc.). Accordingly, several emulators will be developed in order to support testing of DAS in the context of these external interactions.

It is important that DAS be independently tested prior to the actual site-integration with external components in order to flush out problems early. This allows for thorough testing prior to shipping DAS to GRGT and WSGT. However, those SRD requirements whose qualification testing relies on these external interface emulators can only be '*conditionally*' verified as part of the System Qualification

phase. Ultimately, these requirements will need to be verified as part of SAT with the actual external interfaces in place. This is an important part of SAT. These 'conditionally' verified requirements are identified as such in the Verification Planning Table (VPT) of Appendix A. In addition, there are some requirements that require more than one verification case. The VPT denotes these requirements with a 'm' designator.

System Qualification will be accomplished through the successful completion of a number of inspections, analyses, and test cases (which include demonstrations), each of which provides verification of one or more DAS requirements. Section 3 details the specific requirements for each individual inspection, analysis, and test case.

Most of the System Qualification testing will occur in December 2001 and January 2002.

2.2.3 Phase II Verification (FAT)

For DAS, FAT is the final functional testing of the integrated WSGT and GRGT racks prior to shipment to ensure all elements are working. Typically, System Qualification testing is conducted on what is referred to as 'pre-production' equipment. After Qualification, any required modifications are made and the production quantities are produced. This new production equipment is then integrated and tested at the contractor factory. The formal verification that the equipment has been produced and integrated properly then occurs. This verification phase is Factory Acceptance Testing (FAT), and usually consists of functional testing, mostly at the system level. It is substantially reduced in scope to what is required for Qualification testing.

The paradigm for Qualification Testing is somewhat different in DAS because the DAS development program consists of mostly COTS hardware integration but with significant custom software development (e.g., DASCON). Phase I Verification (System Qualification) testing is actually being conducted on the production hardware. The Demodulator Group (DMG) is essentially the only custom hardware item and it will be under going early, extensive performance testing using the IF Test Generator. In fact, the Factory test-bed to be used for Qualification will consist of the same six WSGT and GRGT racks of equipment that will be ultimately shipped for deployment. Accordingly, FAT will consist of straightforward functional testing at the end of Qualification only to ensure that the system is working from a fairly high-level perspective (since significant testing would have just been completed on the same equipment that is to be shipped).

FAT will occur in late January 2002.

2.2.4 Phase III Verification (SAT)

The intent of SAT is to verify several important considerations:

- The equipment has been packed, shipped and unpacked without damage

- The equipment has been re-assembled and integrated properly
- The system works with the actual interfaces (not just the emulators used in Qualification testing).

Towards this end, the System Qualification tests that had previously involved interface emulators (and only *'conditionally-verified')* will be rerun with the actual interfaces as part of SAT to formally complete their verification begun in Phase I. End-to-end verification testing is also a critical component of SAT.

2.3 STRUCTURE

The structured verification process will be implemented to ensure that DAS meets all NASA requirements as specified in the NASA DAS System Requirements Document (SRD), and in the external Interface Control Documents. The following statements characterize and guide the verification process:

- DAS System Qualification consists of multiple inspection, analysis, and test cases to formally prove that DAS system requirements have been satisfied.
- All system requirements are traced to a case and method through the DAS Performance Verification Matrix (PVM).
- Government personnel have the opportunity to witness the conduct of all formal testing.
- The System Qualification Test Procedures (Volume II) detail specific steps/procedures for each Qualification test case presented in Volume I.
- COTS items will be exempted from repeat testing based on manufacturer certification of compliance.

2.4 VERIFICATION METHODS

2.4.1 Method Definitions

Section 2.4 defines the formal methods that will be used for DAS verification. DAS verification is divided into a series of analysis, inspection, and test/demo cases, each of which is designed to verify one or more DAS SRD requirements. In some cases, multiple verification methods may be required to verify a single SRD requirement.

2.4.1.1 Analysis

Analysis is the method used to verify that an item conforms to the specified requirements by evaluating calculations, computations, modeling, simulation, analytical solutions, studies, and reduced or representative data. In performing analysis, verification personnel shall:

- Study and examine engineering drawings, software and hardware flow diagrams, and specifications; or
- Perform modeling and simulation and assess the results; or

- Perform a combination of the two activities above.

2.4.1.2 Inspection

Inspection is the method used to verify the physical characteristics of the product (e.g., size, weight, appearance, adherence to specified standards and engineering practices, and quality of design and construction) by examining the equipment in comparison with associated documentation. Inspection determines conformance to requirements without the use of special test equipment or analysis techniques. In conducting inspections, verification personnel shall:

- Use inspection tools and measurement devices to perform a visual survey of the product; and
- Note the results of their inspection for comparison with the required physical characteristics of the product.

Inspections may be performed during any assembly stage of the product. An example of verification by inspection is measuring the physical dimensions of a chassis. Inspections are different from Analyses in that inspections can typically be performed by QA whereas analysis usually requires system engineering.

2.4.1.3 Demonstration

Demonstration is the method used to verify that an item conforms to the specified requirements by observing the operation and functional performance of the product, or part of the product, generally without the use of special instrumentation to record quantitative measurements. This method is generally used when a requirement does not contain a specific numerical parameter that may be measured. Since no quantitative values are specified for demonstrations, pass/fail criteria are “yes/no” indications of functional performance. An example of verification by demonstration is verifying that a component provides status data.

2.4.1.4 Test

Test is the method used to verify that an item conforms to the specified requirements by thoroughly exercising the applicable item under specified conditions and by using the appropriate instrumentation in accordance with test procedures. Tests are used to measure the attainment of specified numerical parameters. In conducting tests, verification personnel shall:

- Use laboratory equipment or simulators to measure numerical parameters
- Record measured values
- Determine “pass/fail” criteria by comparing measured value(s) with specified value(s).

Measurement accuracy shall be precise enough to ensure that the measured value is within the specified tolerance. Tests may be performed during any assembly stage of the product. An example of verification by test is the BER measurement of the DMU.

2.4.2 Verification Cases Nomenclature

This Verification Plan generates and assigns Verification Cases to all requirements for all three phases as follows:

Exhibit 2.4-1: Verification Case Nomenclature

Verification Phase	Analysis Cases	Inspection Cases	Test/Demo Cases
System Qualification	A#	I#	Q#
FAT	-	-	F#
SAT	-	-	S#

2.5 REQUIREMENTS TRACEABILITY

The NASA DAS SRD ([1]) defines the requirements to be verified. All requirements are documented in the DAS Performance Verification Matrix (PVM), ITT Doc. No. 024-600007 ([5]). The DAS PVM is the primary tool used for tracking requirement verification. The PVM accomplishes the following:

- Identifies the requirements that will be verified by each verification method.
- Allocates all system requirements to DAS subsystems.
- Maps the DAS system requirements to verification methods.
- Provides a formal checklist to ensure that each test or verification is performed and recorded.
- Documents all verification results for each system requirement.

2.6 DAS SUBSYSTEMS AND INTERFACE DEFINITIONS

2.6.1 DAS Subsystems

Exhibit 2.6-1 illustrates the DAS Reference Architecture. The DAS consists of the following subsystems:

- Element Multiplexer/Correlator (EMC) Interface Subsystem: An optical switch in the EMC Interface subsystem provides the interface between WSGT/STGT EMCs and the Independent Beamformer Unit Group (IBUG) subsystem. The EMC Interface subsystem includes the Optical Switch, a Common Data Broadcast (CDB) Switch, and ancillary Ethernet cable connections. A

single EMC can communicate with up to 10 IBUs. The IBUG Controller (ICON) controls the Optical Switch and the Optical Switch controls the CDB.

- IBUG Subsystem: An individual Beamforming Unit (IBU) in the IBUG subsystem accepts Multiple Access (MA) elements from the NASA Tracking and Data Relay Satellite (TDRS) Element Multiplexer/Correlator (EMC) and forms beams to the location commanded by the IBUG Controller (ICON).
- IF Switch Subsystem: Provides the Intermediate Frequency (IF) interfaces between Demodulator Units (DMUs) and IBUs.
- Receiver/Demodulation Group (DMG) Subsystem: An individual Demodulator Unit (DMU) in the DMG subsystem receives IF signals from IF Switch, demodulates the signals, and outputs baseband data to the Archive/Server subsystem via an Ethernet switch.
- Archive/Server Subsystem: Archives, formats, and routes baseband data over the NISN closed IOnet to DAS Customers. The Archive/Server subsystem consists of a network terminal, a router to interface with the GDIS network, and an Ethernet hub to interface with the NISN closed IOnet and with local user interfaces.
- DASCON Subsystem: Provides overall system control with interfaces to (1) the ICONs, (2) the DCONs, (3) SWSI to provide the scheduling and status interface with DAS Customers, and (4) NISN closed IOnet to provide recovered data to DAS Customers. The software is hosted on the DAS Local Control Monitor (LCM).
- ICON Subsystem: Controls the EMC Interface and IBUG/IBUs and manages the interfaces between DASCON, EMC Interface, and Beamformers. The control software is hosted on a workstation terminal.
- DCON Subsystem: Controls the IF Switch and demodulators, and manages the interfaces between DASCON, the IF Switch and Demodulators. The control software is hosted on a workstation terminal.
- Timing and Frequency Subsystem: Provides system timing to the Archive/Server, DCON, ICON, and DASCON and accurate frequency information to the DMG.
- Power and Mechanical Subsystem: Provides electrical power to DAS subsystems and the physical infrastructure to contain the DAS hardware and software equipment components.

2.6.2 DAS External Interfaces

The DAS shall provide recovered data to DAS Customers in accordance with the specifications in the Interface Control Document between the DAS and DAS Customers, 453-ICD-DAS/Customer ([3]).

The DAS shall exchange information with DAS Customers in accordance with the specifications in the Interface Control Document between the DAS the Space Network Web Services Interface (SWSI), 453-ICD-DAS/SWSI ([4]).

The DAS shall interface with the WSC Systems in accordance with the specifications in the Interface Control Document between the Demand Access System and the White Sands Complex, 453-ICD-DAS/WSC ([2]).

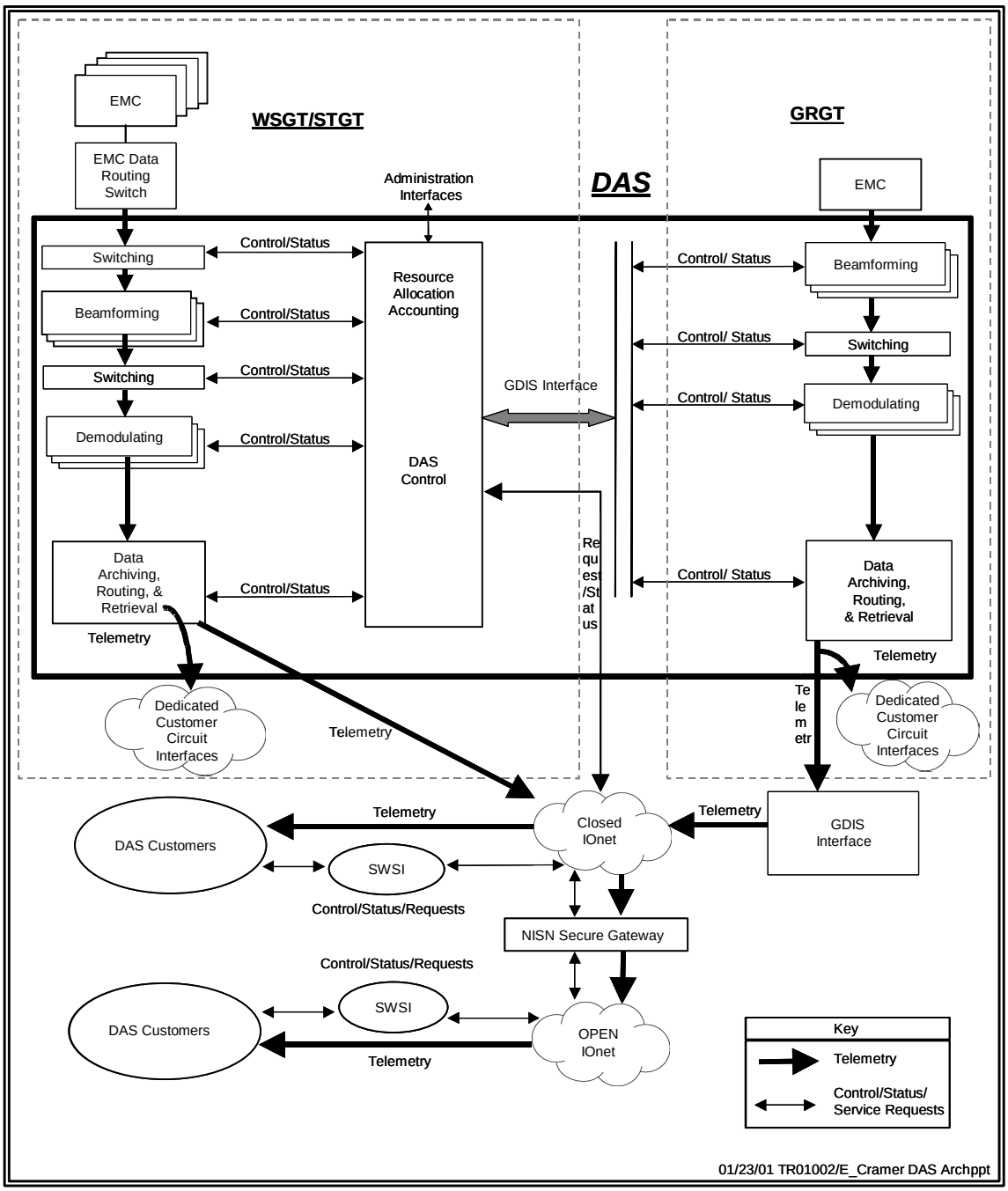

Exhibit 2.6-1: DAS Reference Architecture

2.7 ROLES AND RESPONSIBILITIES FOR TEST EXECUTION

The DAS Test Team will consist of the following:

- Test Director
- System Engineer

- Test Technician
- QA Engineer
- WSC O&M Personnel (for WSC Test Cases)
- NASA Witness.

ITT employees will staff all these roles, except for the NASA Witness and WSC O&M personnel. Each position is described below.

2.7.1 Test Director

The Test Director's specific responsibilities include:

- Notify NASA when testing is ready to begin.
- Review all testing on a daily basis to ensure the Verification Test Procedure is implemented in a timely and quality manner.
- Organize resources and materials required for conduct of all tests.
- Coordinate with the DAS Mission Manager regarding the use of Space Network (SN) resources no later than four weeks prior to the test date.
- Coordinate with WSC O&M personnel before and during the conduct of WSC testing.
- Report daily test status to the ITT DAS Project Manager, the NASA DAS Product Manager, the NASA DAS Integration Engineer, and the DAS Mission Manager (via email).
- Support problem investigation and re-tests of identified problems
- Approve and initial red-lined changes to the Verification Test Procedure.

2.7.2 System Engineer

The System Engineer's specific responsibilities include:

- Develop the Verification Test Procedure.
- Red-line the Verification Test Procedure as necessary.
- Document failures with Corrective Action Requests (CARs).
- Notify the Test Director of all problems that arise during testing.
- Collect all test data at the conclusion of a formal test run.
- Perform any post-test analysis that may be required to complete a test.
- Provide a daily test status report to the Test Director.
- Prepare the Final Verification Test Report.
- Perform separate analyses needed for verification of “Analysis” requirements
- Prepare the Final Verification Inspection and Analysis Report.

2.7.3 Test Technician

The Test Technician's specific responsibilities include:

- Execute the Verification Test Procedure.
- Maintain a daily test logbook, and record significant events, observations, and problem areas.
- Notify the System Engineer and QA Engineer of any problems that arise during Testing.
- Assist the System Engineer in preparing the daily test status report.
- Assist the System Engineer in preparing the Final Verification Test Report.
- Perform inspections needed for the verification of “Inspection” requirement.
- Assist the System Engineer in preparing the Final Verification Inspection and Analysis Report.

2.7.4 Quality Assurance (QA) Engineer

The QA Engineer's specific responsibilities include:

- Review testing to assure that procedures are being followed.
- Approve and initial all red-lines on the Verification Test Procedure.
- Monitor tests to ensure the Verification Test Procedure is followed.
- Report failures to the System Engineer and Test Director.
- Support problem investigation and re-testing.
- Assure closure of CARs and Software Problem Reports (SPRs).
- Review and approve test data.
- Review and approve the Verification Test Procedure, Final Verification Test Report, and Inspection and Analysis Report.
- Verify and record all serial numbers of components (i.e., card level) for chassis under test.

2.7.5 WSC O&M Personnel

WSC O&M personnel’s specific responsibilities include (applicable only during WSC testing):

- Control and monitor the Tracking and Data Relay Satellite (TDRS)
- Control and monitor the MABE, MA calibration equipment.
- Control and monitor the End-to End Test (EET) equipment.
- Coordinate and schedule the EET equipment via Scheduling Orders (SHOs).
- Log MABE and IR data.
- Troubleshoot WSC ground equipment (SGLT) if failures occur.

2.7.6 NASA Witness

The NASA Witness's specific responsibilities include:

- Witness the formal runs of all Verification Testing.
- Provide an independent engineering assessment of the results of the formal test run to the DAS Test Director and the DAS System Engineer.

2.8 TEST LOCATIONS

The DAS System Qualification testing will take place at the locations listed below:

- ITT Industries, Advanced Engineering and Sciences facility in Reston, Virginia (DAS 'Factory')
- NASA White Sands Complex Ground Terminal (WSGT), New Mexico

The Qualification testing planned at each location is shown in Exhibit 2.8-1. This is subject to actual equipment and personnel availability, operational and development schedules, and funding constraints. As shown, the majority of the Qualification effort occurs at the DAS Factory in Reston Virginia. The exhibit also identifies the locations of FAT and SAT.

Exhibit 2.8-1 DAS Test Locations

Verification Phase	Location	Item No.	Qualification Test Objectives	Required Test/Emulator/Interface Resources
System Qual	ITT-Reston (Factory)	1.	DASCON/Customer interactions using SWSI	SWSI Development Environment
		2.	Detailed DMG performance	IF Generator
		3.	Detailed Qualification testing of all SRD requirements except those being verified under Items 1, 2, 4, and 5	Full-up Factory Configuration with: – IF Generator – Pre-production EMC – CTFS Emulators – Factory ECON – NISN Emulator – GDIS Emulator – CTFS SSC I/F Emulator – GSFC SWSI
	WSGT	4.	DMG performance using actual Doppler	Simulation services or shadowing of normal user service
		5.	ECON-EXEC ADPE Interface	EXEC ADPE Interface

Verification Phase	Location	Item No.	Qualification Test Objectives	Required Test/Emulator/Interface Resources
FAT	ITT-Reston	6.	Test that WSGT and GRGT equipment/chassis installed in racks are working as required at a high-level after Qual testing has been performed	Full-up Factory Configuration with: – IF Generator – Pre-production EMC – CTFS Emulators – Factory ECON – NISN Emulator – GDIS Emulator – CTFS SSC I/F Emulator – GSFC SWSI
SAT	WSGT/GRGT	7.	Functional Testing to verify: - Installation - External site interfaces - EET system functionality	– IF Generator – Pre-production EMC (– CTFS Emulators – Pre-production ECON (– CTFS SSC I/F Emulator – GSFC SWSI

2.9 VERIFICATION PHASE SCHEDULE

The schedule for the DAS Verification Phases is shown below in Exhibit 2.9-1.

Exhibit 2.9-1: Verification Phase Schedule

Verification Phase/Activity		Formal	In-formal	Schedule	Associated ATP Volume (DRL-11)	Objectives/Rationale
Phase I: System Qual	DAS Qual Testing TRR	Yes		12/12/01		Establishes all baselines and confirms CM status for all HW, SW and engineering drawings; also reviews all Analysis and Inspection Case results
	Testing	Yes		12/13/01 - 1/21/02	Vol I: Plan Vol II: Procedures	Verifies design against all SRD and ICD requirements (using Emulators and Special Test Equipment where necessary)
Phase II: FAT	DAS FAT TRR		Yes	1/23/02 (Jan/02 MSR)		Establishes all baselines and confirms CM status for all HW, SW and engineering drawings
	Testing	Yes		1/24/02 - 1/25/02	Vol I: Plan Vol II: Procedures	Performs functional testing to verify fabrication, assembly and integration of racks/equipment/cables
Phase III: SAT	Informal Pre-Ship Readiness Review		Yes	1/30/02		Reviews resolution status of all Discrepancy Reports and status of FAT
	Testing - WSGT - GRGT - End-to-End	Yes		2/12/02 - 3/29/02 2/12/02 - 2/18/02 3/07/02 - 3/13/02 3/25/02 - 3/29/02	Vol I: Plan Vol II: Procedures	Functional Testing to verify: - Installation - External site interfaces - End-to-End system functionality
Test Results and Discrepancy Review will be presented at all MSRs from 10/01 to 3/02; this will provide the status for ongoing testing and the resolution of test discrepancies						

2.10 TEST SCHEDULE

The tentative test schedule for Qualification, FAT and SAT are shown below in Exhibits 2.10-1 to 2.10-3, respectively

Exhibit 2.10-1: Tentative Test Schedule For System Qualification

Qualification Test Case Number	Title/Description	Required Resources External to DAS	Tentative Timeframe
Q1	DASCON/Customer interactions using SWSI	GSFC SWSI	Dec-Jan 2001
Q2	Customer interactions and Resource Allocation using LCM	None	Dec-Jan 2001
Q3	Detailed DMG performance using IF Generator	IFG	Sept 2001
Q4	Full-up Factory DAS	- P/P EMC - Factory ECON	Dec-Jan 2001
Q5 Deleted			
Q6	Customer Data I/F using NISN Emulator	NISN Emulator	Dec-Jan 2001
Q7 Deleted			
Q8	DASCON/Alert I/F using CTFS SSC Emulator	CTFS SSC Emulator	Sept 2001
Q9	DMG performance with Doppler	- User Simulator - User S/C	Sept 2001
Q10	ECON - Exec ADPE I/F	WSC Exec ADPE	Sept 2001
Q11	DMG EMI Testing	EMI Labs	Oct 2001
Q12	DAS-WSC EMI Susceptibility Testing	WSGT, GRGT	March 2002

Exhibit 2.10-2: Tentative Test Schedule and Order For FAT (1/24/02-1/25/02)

FAT Test Case Number	Title/Description	Required Resources External to DAS	Tentative Timeframe	ROM Time Duration (hours)
F1	**Power-Up**	None	1/24/02 - 1/25/022	2
F2	**Customer Interactions**	SWSI Development System	1/24/02 - 1/25/02	2
F3	**LCM Support**	None	1/24/02 - 1/25/02	2
F4	**Front-End Processing**	P/P EMC, Factory ECON	1/24/02 - 1/25/02	2
F5	**Back-End Processing**	IFG, NISN Emulator; CTFS Emulator	1/24/02 - 1/25/02	2

Exhibit 2.10-3: Tentative Test Schedule and Order For SAT (2/12/02-3/29/02)

SAT Test Phase	SAT Test Case Number	Title/Description	Tentative Timeframe	ROM Time Duration (hrs)
Phase A: Stand-Alone DAS Testing	**S1**	**Power-Up**	End-of February	3
	S2	**LCM Support**	End-of February	3
	S3	**Front-End Processing**	End-of February	4
	S4	**Back-End Processing**	End-of February	4
Phase B: 'Conditional' Requalification Testing	**S5**	**CTFS SSC Alert I/F**	Beginning of March 2002	4
	S6	**Customer Interactions via SWSI**	Beginning of March 2002	16
	S7	**Customer Data via NISN**	Beginning of March 2002	8
	S8	**Full-up DAS Testing**	Beginning of March 2002	16
Phase C: End-to-End System Testing (EET)	**S9**	**EET Demo 1**	Middle of March 2002	8

2.11 TEST RUNS

All Test Cases will be executed at least twice. One or more dry runs will be executed at ITT-Reston, or at the designated test location, followed by a formal run. The purpose of the dry runs are to verify the Test Procedures (Volume II) and to make any red-lines to the Test Procedures that are necessary to ensure the proper steps are exercised in order to verify requirements. During dry runs, discrepancies may be resolved by the installation of temporary work-arounds with all pertinent information entered in the test logbook. Formal execution of test cases will be performed after a successful dry run has been completed and discrepancies have been disposed, work-arounds have been replaced by permanent fixes, and redlines to the Test Procedures have been reviewed and initialed by the QA Engineer.

Formal runs will be considered the run of record and will be witnessed by the NASA Witness (or NASA designee) and the QA Engineer. Other NASA personnel, at their discretion, will also witness formal runs. At the time of the formal run, the hardware and software items under test will be identified and documented (red-lined) in the DAS Test Procedure documents. Open discrepancies and work-arounds will be documented in Corrective Action Requests and Software Problem Reports. One logbook will be used for recording events for both dry runs and formal runs. Satisfactory completion of the formal run for each test case will constitute completion of the DAS Verification Test. After the completion of each formal test, a one page quick-look report will be generated as part of the Daily Test Status Reports that includes any discrepancies observed and any actions taken to ensure that the test was successfully executed. These quick-look reports will form the basis of the final Verification Test Report.

2.12 TESTS USING SN RESOURCES

The use of WSC resources will be coordinated with WSC O&M personnel at least four weeks prior to testing and will be supported around SN operational activities. The DAS Mission Manager is responsible for the technical coordination of all network test and simulation planning activities and will work closely with the Test Director to ensure that SN resources are available to support DAS Verification Testing. Based on this coordination, the GSFC Test Director will submit scheduling requests in support of Verification Testing and will generate SN test briefing messages at least three working days prior to the verification date.

2.13 REGRESSION TESTING

All modifications made to the baseline after formal testing require that ‘Regression Testing’ be conducted. These ‘fixes’ will be independently verified using specific tests, which exercise the fix in a laboratory test setting. The philosophy here is to develop a regression test that is targeted at exercising the functionality along with associated performance goals related to the change that has been made. The test will be loosely based on requirements verification in that a related judicious subset of requirements will be verified (rather than repeating a complete verification program each time a change is made).

The objective here is to mitigate risk of collateral bugs and unrelated problems by, for example:

- Exercising all screens, databases, interfaces and processing in the controllers
- Exercise all hardware, firmware and interfaces (where possible) in the affected hardware/software.

These tests may also be used prior to all future software, firmware, and hardware revisions.

2.14 REPORTS

Reports include interim and final reports to document verification test results.

2.14.1 Interim Reports

The following interim reports will be generated to document the on-going conduct of the verification tests:

2.14.1.1 Corrective Action Requests and Software Problem Reports.

Each failure detected during verification testing will be recorded by ITT personnel on a Corrective Action Request (CAR), ITT-CSI Product Development Lab Operating Form number OF-14-01. Each CAR will be screened by the on-site ITT Quality Assurance (QA) representative, who, in consultation with the product development managers, will assign someone to analyze the failure and also assign a corresponding due date for completion of the analysis. The assigned person will analyze the test failure, identifying the root cause and proposing corrective action(s) and a due date for implementation of the action(s). If during the analysis a failure is determined to be the result of a problem in software, which is part of the unit under test (UUT), the information will be recorded on a Software Problem Report (SPR). The SPR is ITT-CSI Product Development Lab Operating Form number OF-14-03. ITT QA will close the corresponding CAR. Proposed corrective action(s) will be reviewed and approved by the originator, QA, and the Project Manager, then implemented. QA will follow up on all corrective actions to ensure their correct implementation and effectiveness, and once verified, will close the corresponding CARs.

SPRs will be processed in accordance with a closed-loop procedure similar to that used to process CARs. A Software Configuration Control Board (SCCB) will approve all proposed software corrective actions for implementation and test. Verification of implementation and effectiveness of corrective action(s) for each software problem will be performed by test and QA personnel, and once verified, the corresponding SPR will be closed by QA.

At the end of each day of testing, all CARs and SPRs generated during that day will be forwarded to ITT QA in Reston for entry into CAR and SPR databases, respectively. These databases permit easy tracking and reporting of analysis and corrective action status and follow-up. CARs and SPRs information will be included in the Daily Test Status Reports, and the overall status of all CARs/SPRs will be provided on a weekly basis.

2.14.1.2 Daily Test Status Reports

The Test Director will provide a daily test status report to the ITT DAS Project Manager, the NASA DAS Product Manager, the DAS Mission Manager, and the NASA DAS Integration Engineer at the end of each testing day. This report will include a summary of the test runs conducted that day, test results, problems encountered during testing, and planned activities to resolve the problems.

2.14.1.3 Weekly Updates

Weekly updates will be provided at the status meetings that will occur each week after the testing has been completed.

2.14.2 Final Reports

The following reports will document verification test results:

2.14.2.1 Final Test Report

The Final Test Report documents the results of the formal runs of the Verification Test Procedures and will be in accordance with DID for DAS DRL-13. The Report will use implementation contractor format. The report will be provided in three volumes:

- Volume I: System Qual Testing
- Volume II: FAT
- Volume III: SAT.

At the conclusion of each Verification Testing Phase, the System Engineer, with assistance from the Test Technician, will prepare the appropriate volume of the Final Test Report. The Test Report will include (DID for DAS DRL-13):

1. Identification of the specific test as shown in the Test Procedures
2. Identification of the requirements to be verified
3. Identification of the software and hardware versions used
4. References to applicable Test Plan and Test Procedures
5. Test Results will include:
    a. Identification of those planned objectives for which actual test results were identical with the expected results as specified in the Test Procedures or for which variation between actual and expected results were within specified tolerance. For the latter case, test results will be shown
    b. Identification of those planned objectives for which actual test results differ from expected results beyond specific limits
    c. Identification of any planned test objective for which actual results were not obtained; reasons for not fulfilling such objectives will be stated
    d. Identification of any false or aberrant behavior noted during the test or subsequent analysis
6. Recommendations for subsequent action will be stated, based on the test results, and may include:

a. Redesign of a particular hardware or software component to enable the system or subsystem to meet a specific requirement which was not fulfilled;
b. Revision to the System Requirements Specification or the Detailed System/Subsystem Specification in cases where the test results disclose ambiguity or conflicting requirements.
c. Conducting additional tests to fulfill objectives for which results were not accepted.

7. Any deviations from the approved Test Plan/Procedures that were followed during the official conduct of the test will be documented as revision pages to the affected documents and will be appended to the Report.

2.14.2.2 Final Analysis and Inspection (A&I) Report

The Analysis and Inspection (A&I) Report will document the results of the analysis and inspection verification and will be in accordance with DID for DAS DRL-14. The Report will use implementation contractor format. The System Engineer, with assistance from the Test Technician, will prepare the final A&I Report, documenting the verification of "Analysis" and "Inspection" requirements. The final A&I Report will include (DID for DAS DRL-14):

1. Identification of the specific analysis or inspection case number as shown in the Acceptance Test Plan
2. Identification of the requirements to be verified
3. Objective of the analysis/inspection
4. Documents referenced during the conduct of the analysis or inspection.
5. Results will include:
   a. Detailed description of the analysis/inspection performed
   b. Analysis/inspection results, and explicit confirmation that the applicable requirement was verified or not
6. Recommendations for subsequent action will be stated, based on the analysis/inspection results, and may include:
   a. Redesign of a particular hardware or software component to enable the system or subsystem to meet a specific requirement which was not fulfilled
   b. Revision to the System Requirements Specification or the Detailed System/Subsystem Specification in cases where the analysis/inspection results disclose ambiguity or conflicting requirements
   c. Conducting additional analysis/inspection to fulfill objectives for which results were not accepted.

2.15 CM AND QA PROCESSES

ITT will follow in-house configuration management (CM) and quality assurance (QA) policies and procedures throughout the DAS verification process. Listed below are the ITT's Product Development Lab QA and CM policies and procedures applicable to DAS acceptance testing. Included with each a short description of what each policy/procedure addresses.

[6] "ITT-CSI Product Development Lab Quality Manual", Doc. no. QM-01—Fully defines and describes our quality management system and the authorities and responsibilities of personnel affected by it; provides general procedures for the activities comprising the system and cross-references to the detailed operating procedures applicable to each; and presents the quality

system to our customers to inform them of specific controls that are implemented to assure product quality.

[7] ITT Operating Procedure no. OP-05-02, "Document Control"—Provides instructions and assigns responsibilities for initiation, review, authorization, issue, distribution, and control of changes to documentation.

[8] ITT Operating Procedure no. OP-05-04, "Engineering Change Form (ECF) Procedure"—Provides instructions and assigns responsibilities for initiation, review, authorization, issue, and distribution of ECFs.

[9] ITT Operating Procedure no. OP-11-01, "Control of Inspection, Measuring, and Test Equipment (IM&TE)" —Describes the process for assuring that all IM&TE is accounted for and has valid calibration.

[10] ITT Operating Procedure no. OP-14-01, "Corrective and Preventive Action"—Provides instructions and assigns responsibilities for requesting, analyzing, reviewing, implementing, and verifying the effectiveness of corrective and preventive actions for product, process, and quality system non-conformities.

[11] ITT Operating Procedure no. OP-14-03, "Correction and Prevention of Software Problems"—Provides instructions and assigns responsibilities for requesting, analyzing, reviewing, implementing, and verifying the effectiveness of corrective and preventive actions for non-conformities and proposed changes in software that has been released to CM.

[12] ITT Operating Form no. OF-14-01, "Corrective Action Request (CAR)"—Form and instructions for requesting and processing corrective/preventive action(s).

[13] ITT Operating Form no. OF-14-03, "Software Problem Report (SPR)"—Form and instructions for requesting and processing corrective/preventive action(s) and proposed changes in software that has been released to CM.

[14] Configuration Management Work Instruction no. CMWI-004, CCA Drawing Package Release & Change Control"—Guidelines for the release and subsequent change control of CCA Technical Data Packages (TDPs).

3. SYSTEM QUALIFICATION PLAN (PHASE I VERIFICATION)

3.1 OVERVIEW

DAS System Qualification is divided into a series of analysis, inspection, and test cases, each of which is designed to verify one or more DAS requirements. This section introduces the Analysis, Inspection and Test cases that have been developed to verify that DAS meets all SRD specified requirements. Note that requirements verification by demonstration and test are both allocated to Test cases.

Appendix A (Verification Planning Table - VPT) lists the requirements to be verified by each analysis, inspection, and test case. The VPT groups these requirements by verification case number, so as to clearly define the requirements allocated to each case. The verification cases are provided in the order of: analysis, inspection and test. The Performance Verification Matrix (PVM) supercedes the information in Appendix A. The PVM provides the final trace of requirements to an analysis, inspection, or test/demonstration cases for verification.

Appendix A essentially forms the basis of the verification plan for System Qualification. The format of the appendix is provided below in Exhibit 3.1-1 with the illustration of SRD Paragraph 3.1.9. Column 9 denotes the following:

C = Conditionally verified pending SAT
M = Multiple verification cases required.

Exhibit 3.1-1: Illustration Of Appendix A

1	2	3	4	5	6	7	8	9	10
Row #	**Req ID**	**SRD Sec. #**	**SRD Requirement**	**Method**	**Case No.**	**Verification Approach Description**	**Success Criteria**	**C / M**	**Comments**
1.	147	3.1.9.d	The DAS implementation shall provide for modular expandability for routing Customer data.	Analysis	A1				

There are four requirements that require multiple verification cases as listed below and expanded upon in Appendix A.

Exhibit 3.1-2: Requirements Requiring Multiple Verification Case

Req ID	SRD Sec. #	SRD Requirement	Method	Case No.
222	3.2.4.2.1.6.k	The specified performance shall be achieved for each data channel at the decoder output.	Test Test	Q3 Q9
229	3.2.4.2.1.7.c	The acquisition time shall not exceed 1 second for a C/No value of 36.0 dB-Hz for Mode A or the C/No required for the PE = 10E-5, whichever is greater and the signal dynamics indicated in Section 3.2.4.2.1.2	Test Test	Q3 Q9
241	3.2.4.2.1.13.a	The DAS shall accommodate an input C/No variation of 12 dB, at a rate not to exceed 10 dB/sec, without requiring a reconfiguration.	Analysis Demo	A3 Q3
289	3.3.4.a	The DAS shall interface with the WSC Systems in accordance with the specifications in the Interface Control Document between the Demand Access System and the White Sands Complex, 453-ICD-DAS/WSC.	Demo Demo	Q4 Q10

3.2 ANALYSIS CASES

The Analysis cases for DAS System Qualification are listed in Exhibit 3.2-1. The verification approach and success criteria for each SRD requirement are individually detailed in tabular form in Appendix A by Analysis Case number. Column 3 list SRD paragraphs that contain requirements addressed by each analysis case.

Exhibit 3.2-1: DAS Analysis Cases

1	2	3	4
Analysis Case	**Analysis Title**	**SRD Sections that are 'generally' addressed by Verification Case**	**Number of SRD Requirements Verified**
A1	Deleted		
A2	Deleted		
A3	RFI and Signal Distortions	3.2.4.2.1.2, 3.2.4.2.1.6.o, 3.2.4.2.1.13, 3.2.4.2.1.14	17
A4	Bit Slip and Sync	3.2.4.2.1.8, 3.2.4.2.1.9, 3.2.4.2.1.10, 3.2.4.2.1.12	5
A5	False Acq and Reacq	3.2.4.2.1.11, 3.2.4.2.1.16	3
A6	Return Data Handling	3.1.5.2.2.a, 3.2.5.2.1a, 3.2.7.1.h	3
A7	RMA	4.1, 4.2, 4.3, 4.4	9
A8	Training	8.1, 8.2	8
A9	Maintenance	9.2	7
		Total =	**52**

3.3 INSPECTION CASES

The Inspection cases for DAS System Qualification are listed in Exhibit 3.3-1. The verification approach and success criteria for each SRD requirement are individually detailed in tabular form in Appendix A by Inspection Case number.

Exhibit 3.3-1: DAS Inspection Cases

1	2	3	4
Inspection Case	**Inspection Title**	**SRD Sections that are 'generally' addressed by Verification Case**	**Number of SRD Requirements Verified**
I1	Beamforming	3.1.3, 3.2.3	21
I2	Status Indicators	3.1.7.1.g	1
I3	Design and Construction	5.1, 5.2, 5.3	14
I4	EMI	5.4c, 5.4.d, 5.4.e	3
I5	Installation	6.1.1, 6.2, 6.3	10
I6	Training	8.3, 8.4.1, 8.4.2, 8.5, 8.6	14
I7	Sparing	10.1,10.3, 10.4	8
I8	Security	11.2, 11.3	6
I9	PTP Processing and Routing	3.1.9, 3.2.5.1.1	11
		Total =	**88**

3.4 TEST CASES

3.4.1 Overview and Summary

Verification testing and demonstration for DAS System Qualification are combined into test cases, as summarized in Exhibit 3.4-1. The verification approach and success criteria for each SRD requirement are individually detailed in tabular form in Appendix A by Test Case number. As indicated in Column 4, many test cases are conducted using the 'Full-Up' Factory (FUF) DAS configuration that allows for system-level testing on the integrated DAS System. The FUF configuration is described in Section 3.4.3, while Section 3.4.4 discusses each specific Test Case configuration individually in more detail.

Exhibit 3.4-1: DAS Test Cases

1	2	3	4	5	6
Test Case	**Test Case Title**	**Location**	**Configuration Overview**	**SRD Sections that are 'generally' addressed by Verification Case**	**Number of SRD Requirements Verified**
Q1	DASCON/Customer interactions using SWSI	Reston with Developmental SWSI at GSFC	Full-up Factory DAS including: ・ GSFC SWSI; ・ IP connection between GSFC and ITT Reston	3.1.1.1; 3.1.2.1, 3.1.2.4.2. 3.1.7.2; 3.2.1.1; 3.2.7.2; 3.2.1	42
Q2	Customer interactions and Resource Allocation using LCM	Reston	Full-up Factory DAS	3.1.2.1 - 3.1.2.4; 3.1.5.1;3.1.5.2, 3.1.6, 3.1.7, 3.2.1.1; 3.2.7.1	48
Q3	Detailed DMG performance using IF Generator	Reston	・ IFG ・ DMG/DMU(s)	3.1.4.2; 3.2.4.2	54
Q4	Full-up Factory DAS	Reston	Full-up Factory DAS including: ・ Factory ECON ・ NISN Emulator ・ CTFS SSC Emulator ・ GDIS Emulator ・ EMC Emulator	3.1.2.2.2.d; 3.1.2.3.1, 3.1.2.3.2.e, 3.1.2.4.2.g, 3.1.3.1, 3.1.4.1.a; 3.1.6; 3.1.7.1, 3.1.8.1- 3.1.8.3; 3.1.9; 3.2.2.4.2; 3.2.4.1; 3.2.5.2.1; 3.2.6.a, 3.2.7.1; 3.3.3.a; 4.2.1, 4.2.2, 9.2.1.1.a, 11.1.a, 11.4.b	59
Q5 (Deleted)					0
Q6	Customer Data I/F using NISN Emulator	Reston	Full-up Factory DAS including: ・ NISN Emulator	3.1.5.1.2 – 3.1.5.1.4 3.2.5.1.1 – 3.2.5.1.4	15
Q7 (Deleted)					0
Q8	DASCON/Alert I/F using CTFS SSC Emulator	Reston	Full-up Factory DAS including: ・ CTFS SSC Emulator	3.1.7.1.f	1
Q9	DMG performance with Doppler	WSGT	WSGT EMC inputs and: ・ User Simulator ・ MAR User Service ・ IBUG ・ DMG ・ DCON	3.1.4.2; 3.2.4.2	6
Q10	ECON - Exec ADPE I/F	WSGT	Actual WSC Exec ADPE upgraded to provide TDRS SV to ECONs	3.3.4.a	1
Q11	DMG EMI Testing	EMI Labs	Fully-populated DMG	5.4.g	1
Q12	DAS-WSC EMI Susceptibility Testing	WSGT, GRGT	Operational DAS and on-going TDRSS services at WSGT and GRGT	5.4.f, 5.4.h	2
				Total =	**229**

System Qualification Testing is conducted using the Production equipment that will ultimately be deployed at WSGT and GRGT. Exhibit 3.4-2 is a list of these key components. The FUF DAS will comprise of the equipment listed in the table.

Exhibit 3.4-2: DAS Production Equipment Available for System Qualification

CI/Subsystem		WSGT	GRGT
1.	EMC I/F	1 FO Switch; 1 CDB switch	NA
2.	Beamforming	2 IBUGs	1 IBUG
3.	IF Switch	1 Chassis; 3 port cards	1 Chassis; 3 port cards
4.	Demodulation	1 DMG	1 DMG
5.	PTP	1 PTP – 25 Channels	1 PTP – 25 Channels
6.	DASCON	1	NA
7.	DCON	1	1
8.	ICON	1	1
9.	Frequency and Timing	Complete	Complete
10.	Mechanical & Power	3 populated racks	3 populated racks

For System Qualification Testing, the WSGT and STGT equipment will be assembled into their respective three racks using the same configuration as that to be deployed at the ground terminals.

3.4.2 Emulators for System Qualification Testing

System Qualification Testing will also utilize several emulators as noted earlier in Column 4 of Exhibit 3.4-1 and as summarized below in Exhibit 3.4-3. Block diagrams for these emulators are presented in Exhibits 3.4-4 to 3.4-8.

Exhibit 3.4-3: Emulators for System Qualification Testing

Emulator	Description	Comments on Formal Verification
CTFS Emulator	- COTS IRIG-G GeneratorCustom board to convert to RS422 - Provides IRIG-G and 1 pps	Provides the identical signal to that is provided by the CTFS
EMC Emulator (TGBFS P/P EMC)	- Preproduction Model built under TGBFS - Same Output and I/Fs as Production EMCs at WSC - Allows for multiple copies for testing EMC I/F CI	In EMC 'Data Generator' test mode can only generate a CW signal so adequate to verify EMC I/F CI and Beamformer CI but not DMG nor DSER
IF Signal Emulator (IF Generator - IFG)	- Combination of COTS and custom boards - Provides entire range of signalling parameters - Currently cannot simulate Doppler on the signal - Provides signal at 8.5 MHz IF ('after beamformer')	Significant characterization and testing of the demod can be performed. However will need to verify Doppler aspects related to the Demod at WSC
NISN Emulator	- Consists of NIC card and a PC - Does not address WDISC formatting	Provide sufficient emulation of the NISN I/F that formal verification testing as appropriate can be conducted
ECON Emulator (Factory ECON)	- ITT has updated the ECON to support DAS - This ECON is the same as that deployed for WSC - TDRS SV will be entered manually vs the Exec ADPE I/F	Readily supports formal verification testing
GDIS Emulator	- Consists of routers to emulate the DAS I/F's with GDIS - Will connect DAS components on 'other side' of router from DASCON	DAS does not need to verify GDIS operation so that this should be sufficient for formal verification
CTFS SSC Emulator	- Will use emulator just as done on TGBFS - Straightforward to implement	Require the use of CTFS SSC Alert for verification testing as appropriate

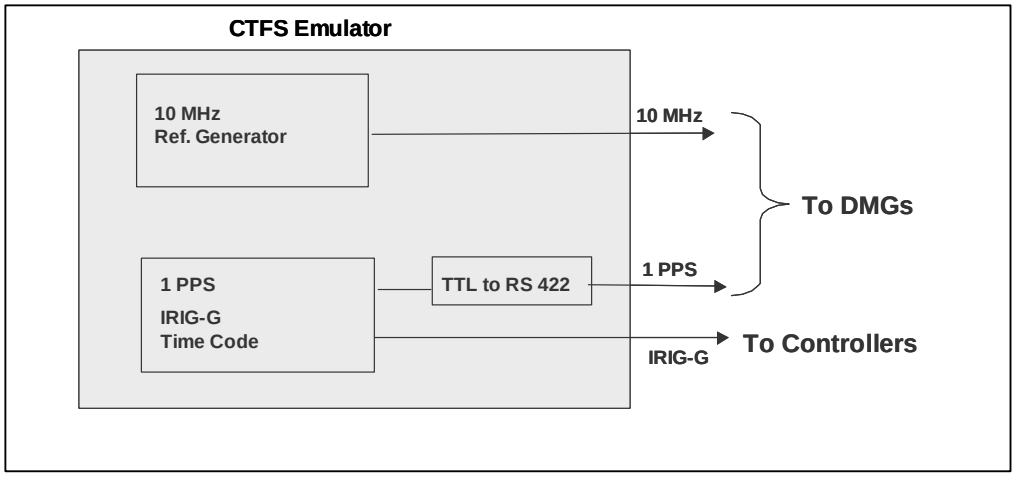

Exhibit 3.4-4: CTFS Emulator

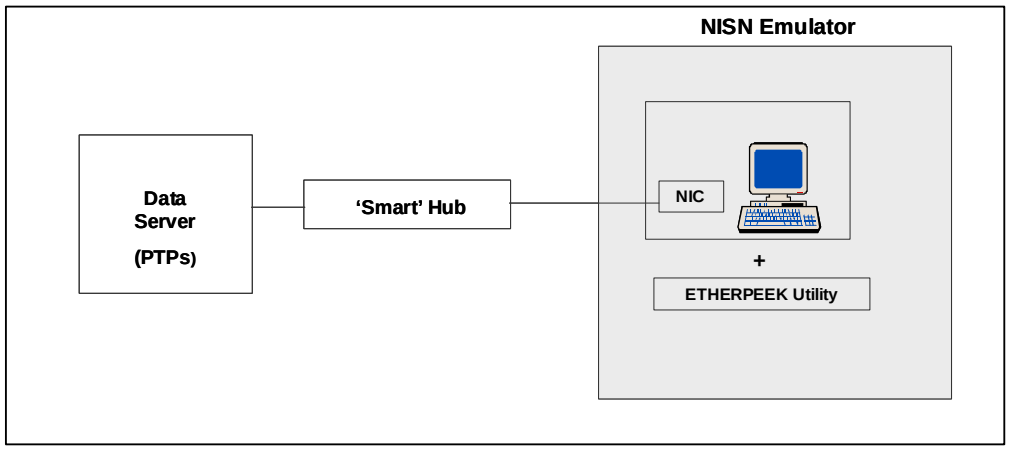

Exhibit 3.4-5: NISN Emulator

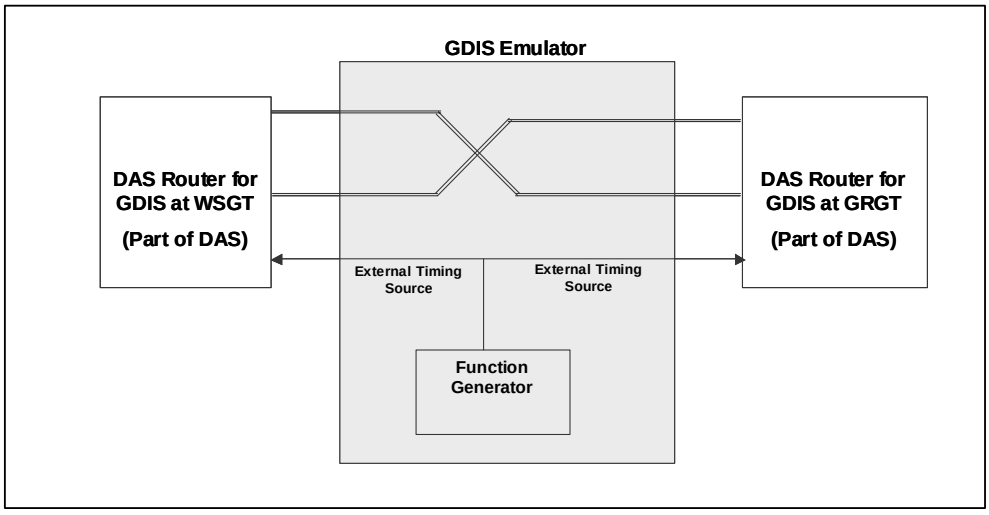

Exhibit 3.4-6: GDIS Emulator

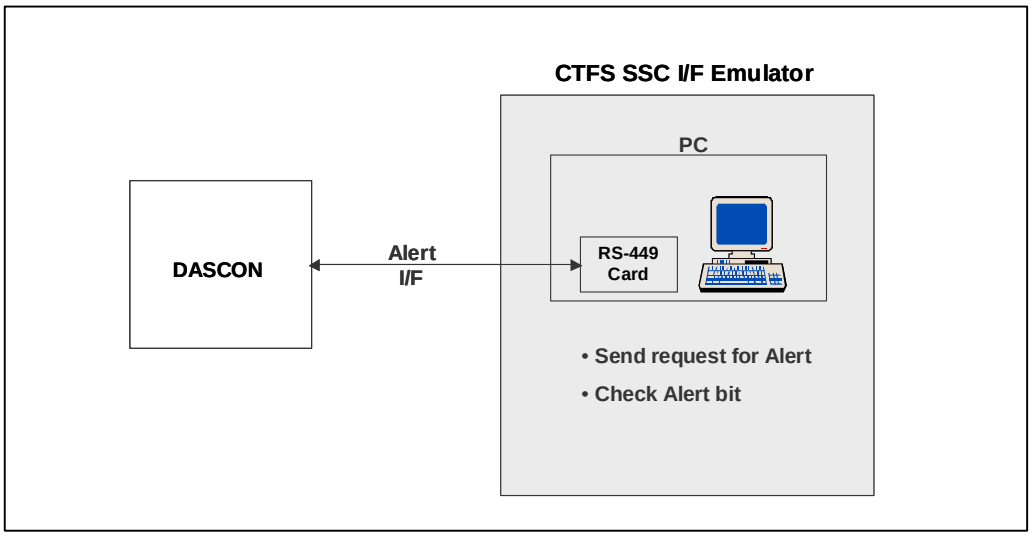

Exhibit 3.4-7: CTFS SSC I/F Emulator

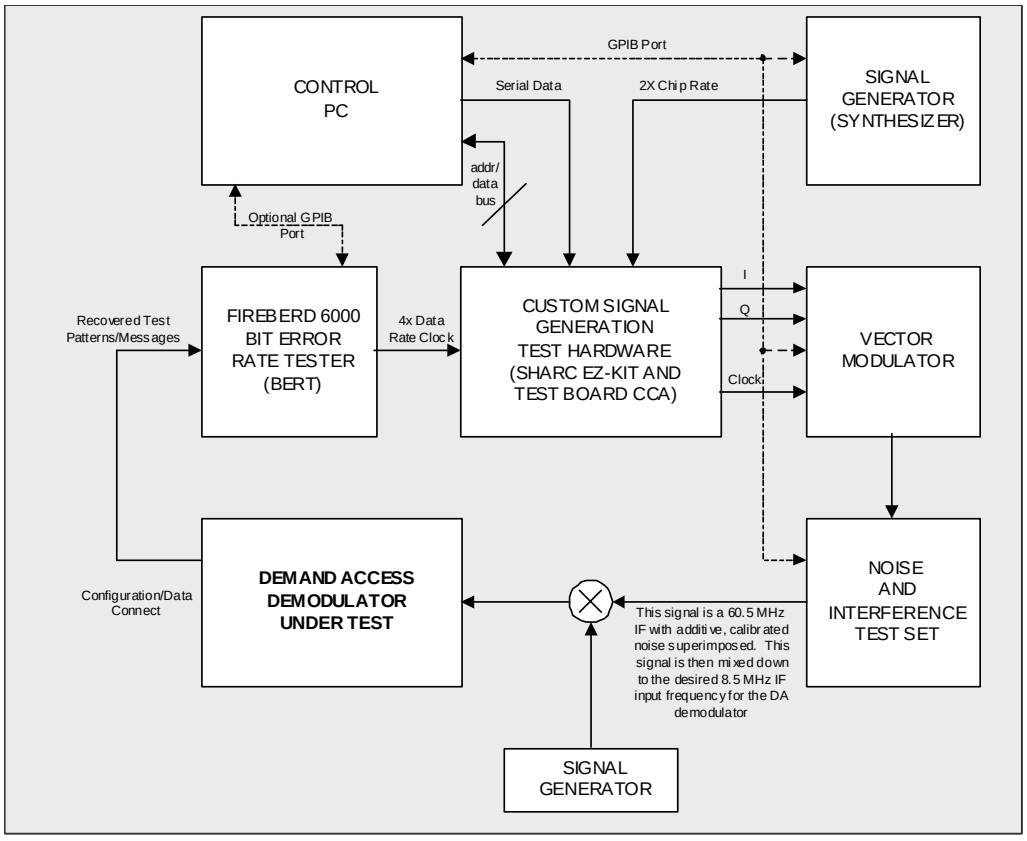

Exhibit 3.4-8: IF Generator (IFG)

3.4.3 Full-up Factory (FUF) DAS Description

As noted previously, many of the test cases for System Qualification use the Full-up Factory (FUF) DAS configuration. This configuration uses the Production equipment listed in Exhibit 3.4-2. The WSGT and GRGT equipment will be located in their respective racks. The FUF DAS will also use several emulators (Exhibit 3.4-1) to support testing. Exhibit 3.4-9 and Exhibit 3.4-10 describe the FUF configurations for WSGT and GRGT, respectively, showing both the Production equipment and the emulators. Additional descriptions are provided in ensuing subsections that individually address each System Qualification test case.

There is no readily available test equipment or emulator that can generate a DAS input signal that reflects the EMC output of a MAR DG1 Mode 2 signal that DAS is required to support. Under 'Data Generator' test mode, the EMC can output a CW signal, which allows for testing of the EMC I/F CI and the IBUGs. On the other hand, the IFG can generate a DG1 Mode 2 signal at 8.5 MHz which would need to be provided after the IBUGs, and thus can test the IF Switch, the DMGs, and the PTPs. Accordingly, there is no end-to-end test that can be conducted as part of System Qualification, but nonetheless significant testing can be accomplished using the IFG, the P/P EMC and the other emulators noted earlier.

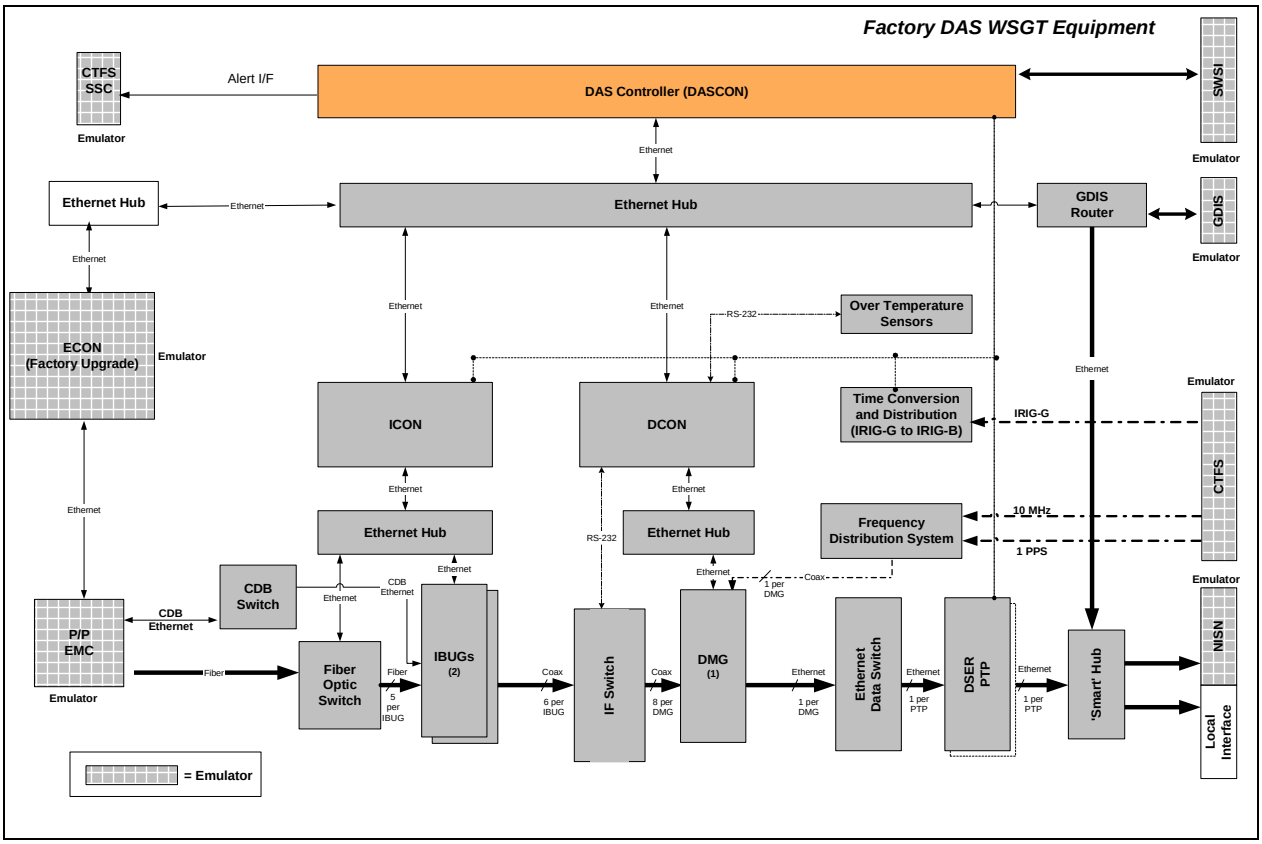

Exhibit 3.4-9: WSGT Equipment Configuration for 'Full-up Factory' DAS

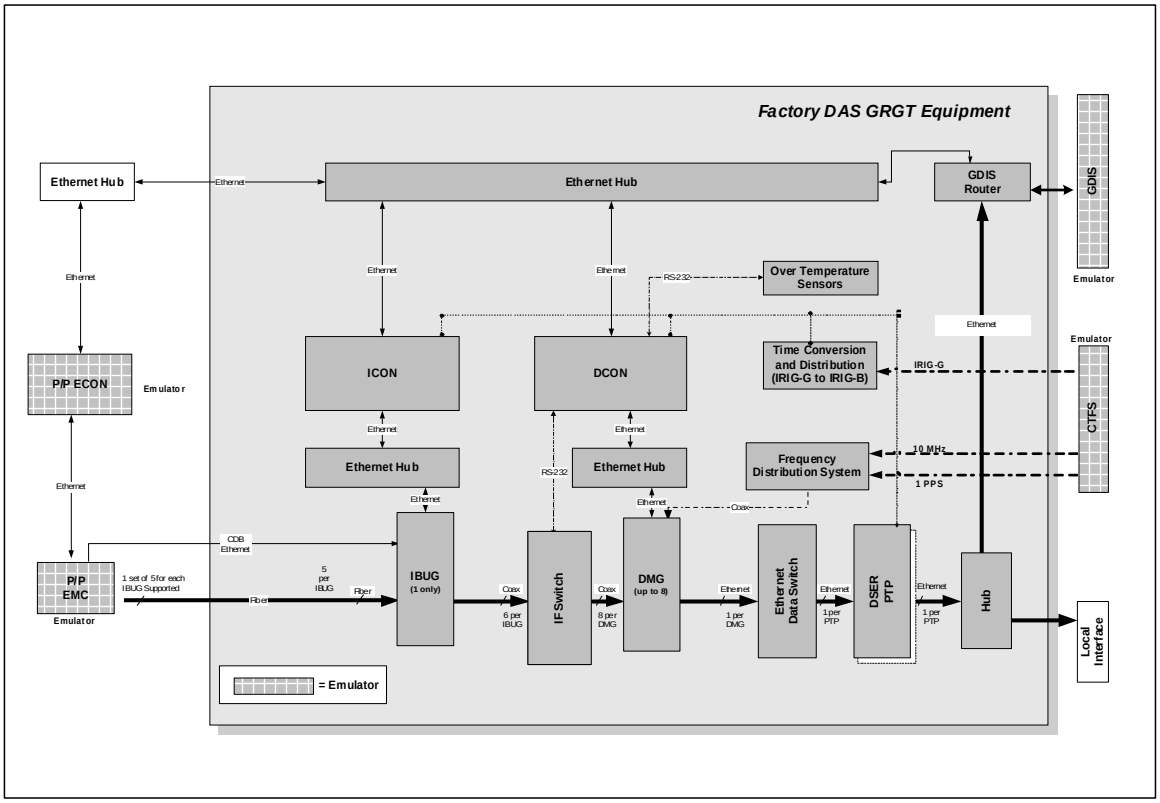

Exhibit 3.4-10: GRGT Equipment Configuration for 'Full-up Factory' DAS

3.4.4 Test Case Descriptions

Each System Qualification Test Case is addressed in turn below.

3.4.4.1 Test Case Q1 - DASCON/Customer Interactions Using SWSI

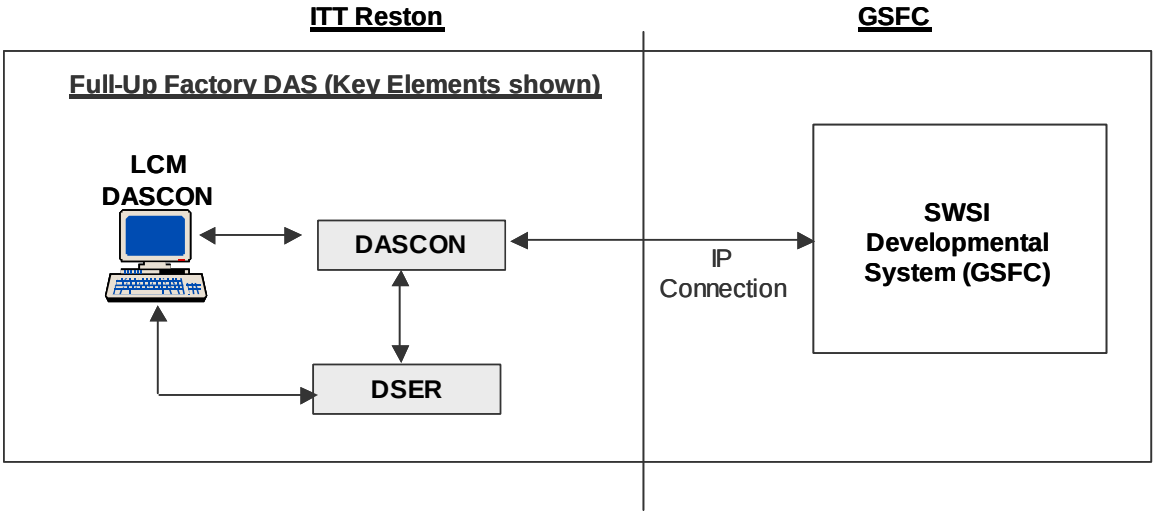

Exhibit 3.4-11: Test Case Q1: DASCON/Customer Interactions Using SWSI

The exhibit highlights the key elements of the FUF DAS used in Test Case Q1. The objective of Test Case Q1 is to verify that DAS supports customer interactions for scheduling, and that DAS provides service status and performance data to customers. Appendix A (Test Case Q1) identifies the specific requirements to be verified.

In Test Case Q1, the FUF DAS will be connected via the NISN open IO network to the Developmental SWSI back-end server. Both systems will be demonstrating the capabilities to exchange messages as described. Using the Controller displays, the operator will issue commands to DASCON and monitor the resultant status on the Controller displays and the front panels of the DSER, DASCON and LCM display. Time tags displayed in the Controller logs will be used to determine status update rate.

The IFG will be used to generate user signals that can be recovered by the DMUs, processed by the PTPs and provided to the NISN Customer emulator. The SWSI I/F will be monitored to demonstrate that UPD data is provided to the customer, as requested, during data demodulation and recovery.

Appendix A (Test Case Q1) details the test approach for each requirement and the corresponding success criteria. Among other items, Test Case Q1 must demonstrate the following:

- DAS and DASCON provide Customer with the capability of entering, storing, updating and retrieving constant parameters that are included routinely in requests for resource allocations.
- DAS automatically retrieves and attaches information to a resource allocation request and reports performance and status data when requested.
- DAS collects and reports performance status for all DAS Customer services
- DAS properly interfaces with the SWSI Interface in accordance with the SWSI ICD.

3.4.4.2 Test Case Q2 – Customer Interactions and Resource Allocation Using LCM

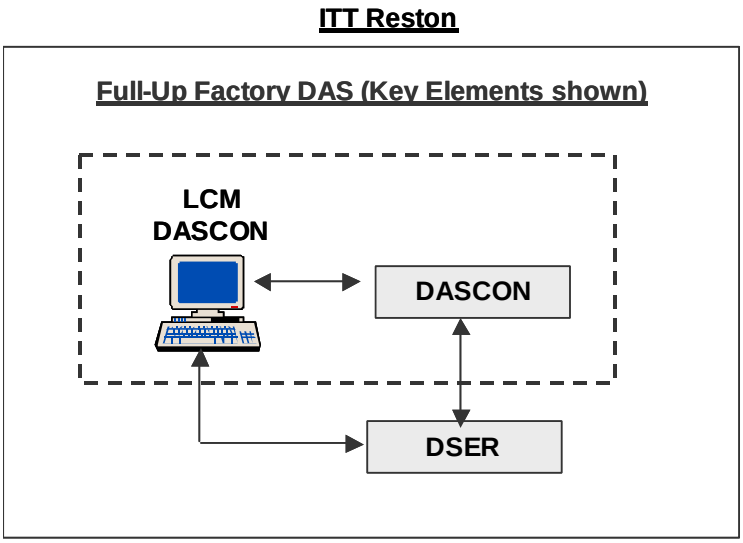

Exhibit 3.4-12: Test Case Q2: Customer Interactions and Resource Allocation Using LCM

The exhibit highlights the key elements of the FUF DAS used in Test Case Q2. The objective of Test Case Q2 is to verify that DAS via the LCM supports customer interactions for scheduling, and that DAS performs DAS equipment resource allocation per schedule and user requests. Appendix A (Test Case Q2) identifies the specific requirements to be verified.

In Test Case Q2, the FUF DAS need not necessarily be connected to the Developmental SWSI. This allows testing to occur at times when the Developmental SWSI cannot support DAS Testing. For convenience, parts of both Q1 and Q2 may be conducted together. Test Q2 will be similar to Q1, except that the LCM display and input interface will replace that of the SWSI I/F.

Using the Controller displays, the operator will issue commands to DASCON and monitor the resultant status on the Controller displays and the front panels of the DSER, DASCON and LCM display. Time tags displayed in the Controller logs will be used to determine status update rate.

Appendix A (Test Case Q2) details the test approach for each requirement and the corresponding success criteria. Among other items, Test Case Q2 must demonstrate the following:

- DAS automatically assesses, logs and reports resource allocation status for a specific DAS Customer.
- Status report summarizes and provides status as it applies to a specific DAS Customer.
- The system identifies and reports system status updates and conditions of resource allocation change in response to requests made by DAS Customers.
- DAS provides availability assessments in response to resource allocation planning requests subject to availability of combined automated emitter visibility and DAS assets availability analysis results.

- DAS automatically assigns DAS resource allocations in response to requests made by DAS Customers based on the combined TDRS to Customer visibility and resource availability results.
- DAS provides local control and monitoring interface to the LCM.
- DAS provides for modifications to DAS Customer identification data.

3.4.4.3 Test Case Q3 – Detailed DMG Performance Using IF Generator

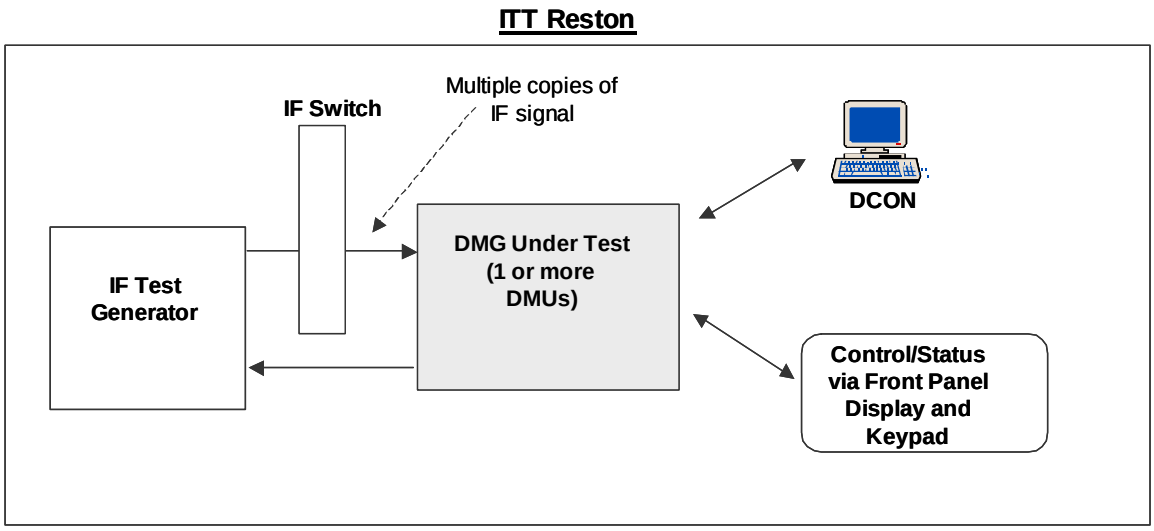

Exhibit 3.4-13: Test Case Q3: Detailed DMG Performance Using IF Generator

The exhibit highlights the key elements used in Test Case Q3. The objective of Test Case Q3 is to verify that DAS achieves the required demodulation functional and performance requirements. Appendix A (Test Case Q3) identifies the specific requirements to be verified.

In Test Case Q3, the IF Signal Generator will be used to provide signal inputs to enable detailed and exhaustive testing of the demod functional and performance requirements over a wide range of signal conditions. Appendix B lists the detailed test runs that will be conducted. Both acquisition and BER performance will be verified. Acquisition testing will consists of many trials to measure the required high acquisition probability with a high level of confidence. BER testing will consist of sending a bit stream that is long enough to provide good confidence; this will typically involve a bit length that is ten times longer that the inverse BER value under test.

The IFG can generate a range of C/No's, all required data rates, all modulation schemes, and all but a few of the signal configurations required by the DAS SRD. These exceptions are:

- I:Q Power Imbalance
- Signal Doppler.

Test Case Q9 (to be conducted at WSGT), will allow for DMU testing of these additional requirements. The IF Switch, shown in Exhibit 3.4-13, is used to generate copies of the IFG output signal so that multiple DMUs can be tested. The exhibit also shows that control may be accomplished either via the DCON or the Front Panel Display.

Appendix A (Test Case Q3) details the test approach for each requirement and the corresponding success criteria. Among other items, Test Case Q3 must demonstrate the following:

- DMU achieves the signal acquisition requirements as stated in the SRD
- DMU achieves the signal tracking requirements as stated in the SRD.

3.4.4.4 Test Case Q4 - Comprehensive DAS Functional and Performance Testing

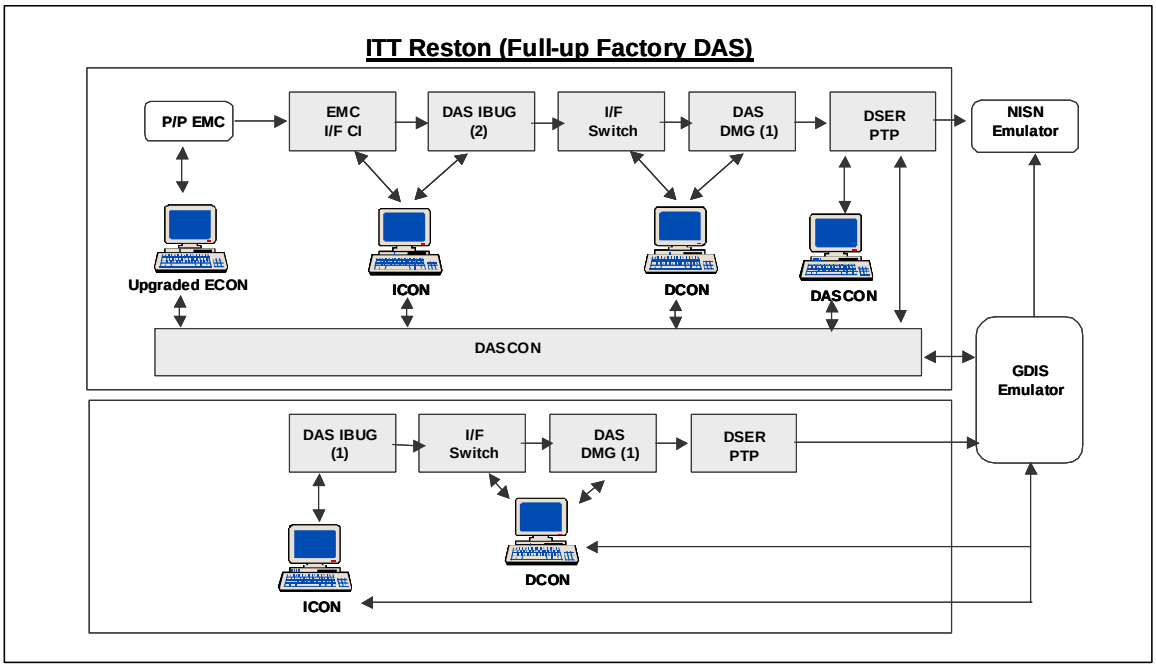

Exhibit 3.4-14: Test Case Q4: Comprehensive DAS Functional and Performance Testing

The exhibit highlights the key elements of the FUF DAS used in Test Case Q4, which is essentially all of the FUF DAS (detailed earlier in Exhibits 3.4-9 and 3.4-10). The objective of Test Case Q4 is to verify a wide range of DAS functionality relating to status monitoring, resource allocation requirements, Customer support, and maintenance. Appendix A (Test Case Q4) identifies the specific requirements to be verified.

In Test Case Q4, the DASCON interfaces with ECON, DSER, ICON and DCON will be tested. Among several other maintainability and operability items, actual removal and replacement of LRUs without removing any other equipment will be demonstrated. The upgraded ECON at the DAS Factory (ITT, Reston) will provide TDRS SVs to verify proper vector management of TDRS SVs

Appendix A (Test Case Q4) details the test approach for each requirement and the corresponding success criteria. Among other items, Test Case Q4 must demonstrate the following:

- DAS collects and reports system wide status of the hardware and software components that constitute the DAS.
- DAS collects and reports performance status and service accounting for Customer services.
- DAS provides Customers with MA return data processing, formatting, distribution, archiving and retrieving capabilities.
- DAS provides a local control and monitoring interface to operators for O&M.
- DAS provides for automated startup and shutdown control of the DAS, addition and removal from the shared pool of resources and modify the DAS Customer identification data.
- DASCON, DCON and ICON control and monitor the DAS equipment
- DAS automatically manages TDRS and DAS Customer vector data including ephemeris generation, storage and removal using state vectors
- DAS automatically generates DAS Customer emitter ephemeris from DAS Customer supplied emitter Type 1 (on-orbit) and Type 8 (stationary) state vectors.

3.4.4.5 Test Case Q5 – Deleted

3.4.4.6 Test Case Q6 – Customer Data I/F Using NISN Emulator

ITT Reston

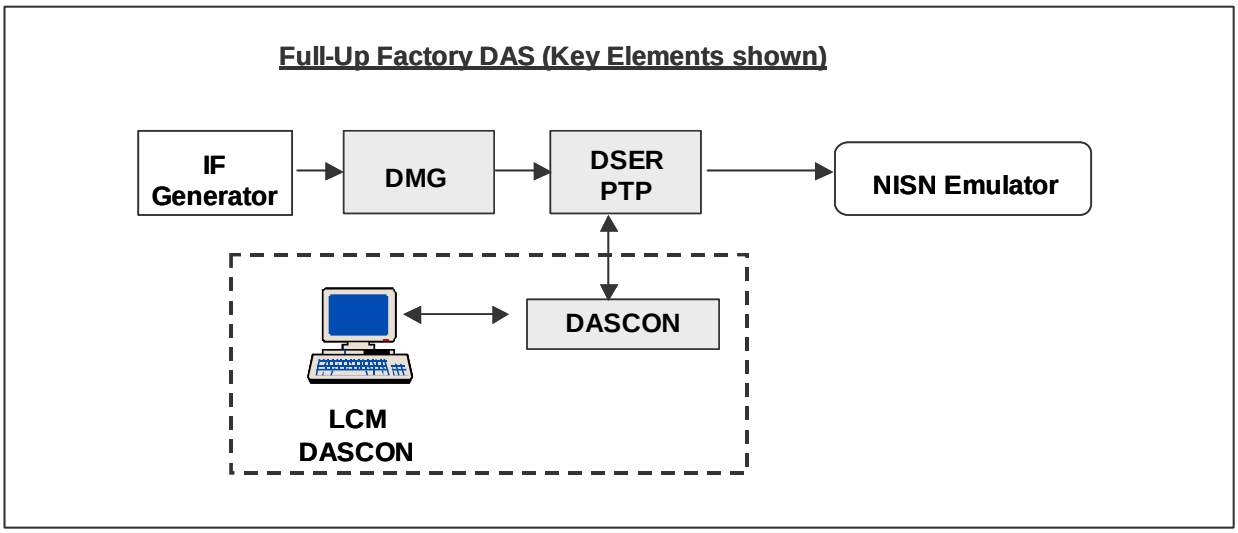

Exhibit 3.4-15: Test Case Q6: Customer Data I/F Using NISN Emulator

The exhibit highlights the key elements of the FUF DAS used in Test Case Q6. The objective of Test Case Q6 is to verify that DAS supports the provision of Customer Data via NISN. Appendix A (Test Case Q6) identifies the specific requirements to be verified.

In Test Case Q6, the NISN emulator will be used with DSER to demonstrate the requirements associated with return data handling and provision of this data to Customers. The IFG and DMG are used to generate the data for transfer via the NISN emulator.

Appendix A (Test Case Q6) details the test approach for each requirement and the corresponding success criteria. Among other items, Test Case Q6 must demonstrate the following:

- DAS provides the capability to route MA return data distribution, archiving and retrieving capabilities.
- DAS provides the capability to route return data obtained in real-time or retrieved from the archive.
- DAS retrieves the designated MA return data from archive at the times specified in DAS Customer requests for resource allocations.
- DAS transmits MA telemetry data to DAS Customer destinations based on routing information.
- DAS automatically manages the storage and removal of archived return data.
- DAS archives the return data and logs the archiving event in the DAS Customer service accounting data if designated to do so in the DAS Customer request specifications.
- DAS automatically removes data that has exceeded its specified lifetime limit from the return data archive.

3.4.4.7 Test Case Q7 – Deleted

3.4.4.8 Test Case Q8 – DASCON/Alert I/F Using CTFS SSC Emulator

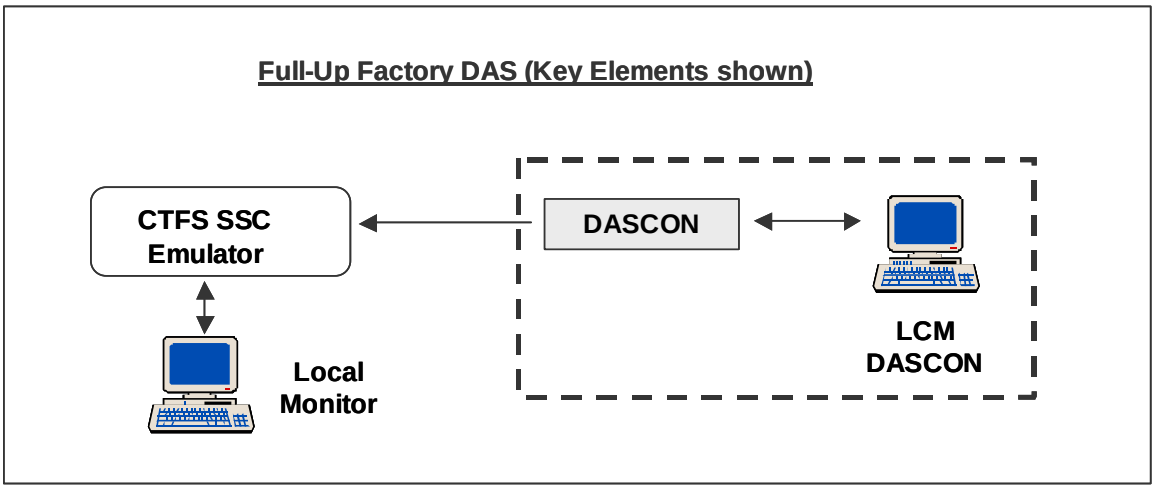

Exhibit 3.4-16: Test Case Q8: DASCON/Alert I/F Using CTFS SSC Emulator

The exhibit highlights the key elements of the FUF DAS used in Test Case Q8. The objective of Test Case Q8 is to verify the DASCON Alert I/F with the CTFS SSC. Appendix A (Test Case Q8) identifies the specific requirements to be verified.

In Test Case Q8, DASCON will send alerts to the CTFS SSC emulator. Appendix A (Test Case Q8) details the test approach for each requirement and the corresponding success criteria. Among other items, Test Case Q8 must demonstrate that DAS sends alerts to the CTFS SSC as specified in the DAS SRD.

3.4.4.9 Test Case Q9 – DMG Performance with Doppler

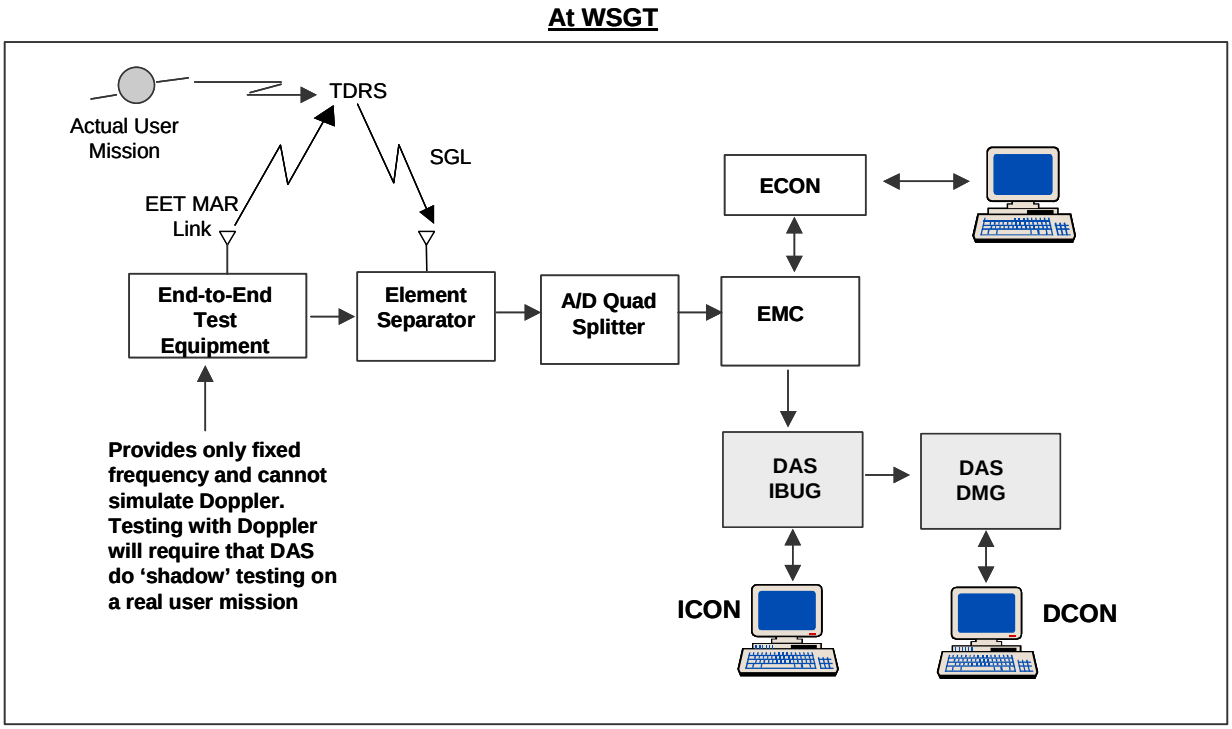

Exhibit 3.4-17: Test Case Q9: DMG Performance with Doppler

The exhibit highlights the key elements used in Test Case Q9. The objective of Test Case Q9 is to verify DMU acquisition and tracking with Doppler and I:Q Power Imbalance on the user signal. Appendix A (Test Case Q9) identifies the specific requirements to be verified.

Selective DAS equipment will be brought to WSGT and a user signal from an actual TDRSS LEO user will be provided via the EMC to the DAS equipment. Note that the IF generator testing in Test Case Q3 cannot impose a Doppler component on the input test signal, nor a I:Q Power imbalance > 12%.

Appendix A (Test Case Q9) details the test approach for each requirement and the corresponding success criteria. Among other items, Test Case Q9 must demonstrate the following:

- Demod achieves the signal acquisition requirements with Doppler and I:Q Power imbalances up to 1:4
- Demod achieves the signal tracking requirements with Doppler and I:Q Power imbalances up to 1:4.

3.4.4.10 Test Case Q10 – ECON – Exec ADPE I/F

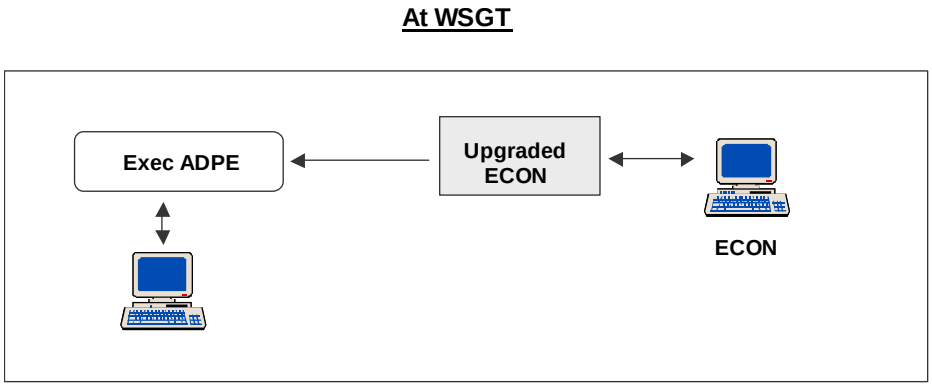

Exhibit 3.4-18: Test Case Q10: ECON – Exec ADPE I/F

The exhibit highlights the key elements used in Test Case Q10. The objective of Test Case Q10 is to verify the ECON I/F with Exec ADPE. Appendix A (Test Case Q10) identifies the specific requirements to be verified. These requirements are driven by the WSC/DAS ICD ([2]).

The upgraded ECON will be brought to WSGT once the Exec ADPE has also been upgraded to accommodate the new requirement to support provision of TDRS SVs to DAS via the ECON.

Appendix A (Test Case Q10) details the test approach for each requirement and the corresponding success criteria. Among other items, Test Case Q10 must demonstrate that the upgraded ECON can receive TDRS SV updates from the Exec ADPE in accordance with the WSC/DAS ICD.

3.4.4.11 Test Case Q11– DMG EMI Verification

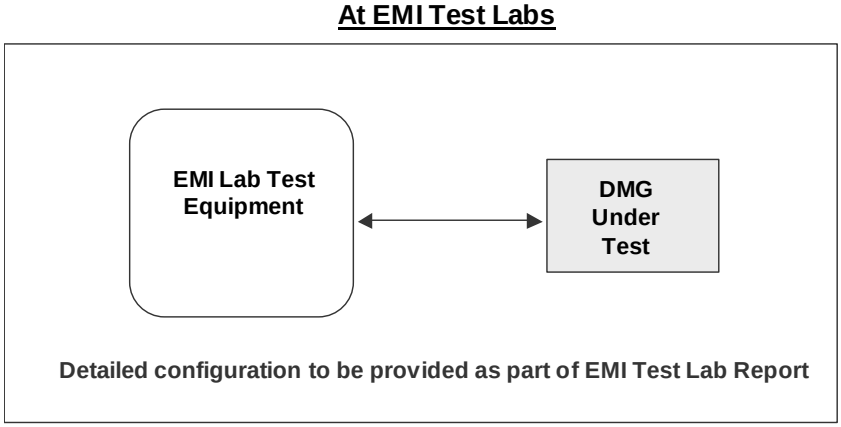

Exhibit 3.4-19: Test Case Q11: DMG FCC Class A EMI Testing

The exhibit highlights the key elements used in Test Case Q11. The objective of Test Case Q11 is to verify that the DMG conforms to FCC Class A EMI requirements. Appendix A (Test Case Q11) identifies the specific requirements to be verified.

EMI verification will be performed at a EMI test facility, at which FCC Class A EMI testing will be conducted on a DMG chassis.

Appendix A (Test Case Q11) details the test approach for each requirement and the corresponding success criteria. Test Case Q11 must verify that the DAS DMG conforms to FCC Class A.

3.4.4.12 Test Case Q12 – DAS-WSC EMI Susceptibility Testing

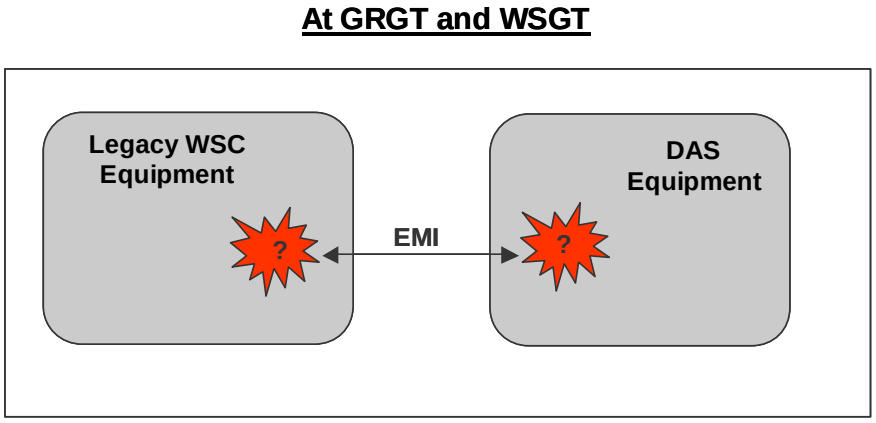

Exhibit 3.4-20: Test Case Q12: EMI Interference Assessment at GRGT and WSC

The exhibit highlights the key elements used in Test Case Q12. The objective of Test Case Q12 is to verify that DAS and WSC equipment do not interfere with one another in terms of EMI emission. Appendix A (Test Case Q12) identifies the specific requirements to be verified.

After installation of DAS at GRGT and WSGT, operation of DAS and legacy equipment will be monitored to detect any degradation.

Appendix A (Test Case Q12) details the test approach for each requirement and the corresponding success criteria. Test Case Q12 must verify that DAS and legacy WSC equipment are not degraded.

4. FAT TEST PLAN (PHASE II VERIFICATION)

4.1 INTRODUCTION

4.1.1 Background

FAT Testing represents the second of three phases of formal DAS verification. As discussed in Section 2.2.3, the focus of FAT is the final checkout of equipment that has just undergone Qualification testing. Accordingly, FAT will be straightforward, involving functional testing to verify that the DAS equipment in their racks and with their interconnects are functioning properly. FAT is needed to ensure after several weeks of individual Qualification testing that the DAS equipment is functioning 'end-to-end' (at least to the extent that can be tested within the DAS Factory environment). After successful FAT completion, the equipment will be packed and shipped to their respective TDRSS Ground Terminals.

4.1.2 Purpose

The FAT Test plan provides the basis for testing the functionality of the DAS equipment when configured in their deployed rack configuration. The functional tests are designed to ensure high-level technical compliance with the DAS hardware and functional requirements prior to delivery and installation.

4.1.3 Scope

This FAT Test plan includes an overview of the specific tests to be conducted in terms of:

- Test identification
- Key functions to be demonstrated
- Key interfaces to be demonstrated
- The order of test execution
- Evaluation of the completeness of the FAT.

4.2 TEST PLAN OVERVIEW

The DAS FAT will take place at the ITT/AES facilities in Reston, Va. The equipment being tested consists of the three WSGT racks and the three GRGT racks in the FUF DAS configuration shown previously in Exhibit 3.4-9, 3.4-10 and 3.4-14.

As noted earlier in Section 3.4.3, there is no readily available test equipment or emulator that can generate a nominal DAS input signal that would allow end-to-end testing. Under 'Data Generator' test mode, the P/P EMC can output a CW signal, which allows for testing of the EMC I/F CI and the IBUGs, but not the processing components thereafter (i.e., IF Switch, DMG and PTPs). These latter components are tested using the IFG, which can generate a DG1 Mode 2 signal at 8.5 MHz. This IF signal is injected

into the IF Switch input ports, bypassing the beamforming function. Also, since the SWSI and Operator LCM Interfaces are critical, these interfaces are tested explicitly as part of FAT.
With these considerations in mind, Exhibit 4.2-1 lists the five DAS tests that comprise FAT.

Exhibit 4.2-1:DAS FAT Test Cases

1	2	3	4	5
FAT Test Case #	**FAT Test Title**	**Key Functions to be Demonstrated**	**Key External I/F's to be Demonstrated**	**Test Overview**
F1	**Power-Up**	- Power -Up - BIST - Status Reporting		- Power up all WSGT Equipment - Power up all GRGT Equipment - Connect Emulators
F2	**Customer Interactions**	- Service Planning - Alerts - UPDs - Data Playback	- SWSI	- Request service - Send resource availability data - Initiate Service - Provide UPD to SWSI - DASCON commanding - Status Reporting and Collection - Request Parameter Change during service - Request Playback
F3	**LCM Support**	- Service Planning - Alerts - UPDs - Data Playback - Delogging	- Operator/LCM	- Request service - Send resource availability data - Initiate Service - DASCON commanding - Status Reporting and Collection - Request delog - Set up maintenance event
F4	**Front-End Processing**	- EMC Switching - Beamforming	- EMC	- Generate CW Tone using P/P EMC - Switch EMC output to multiple IBUs - DASCON commanding - Status Reporting and Collection
F5	**Back-End Processing**	- Demodulation - IF Switching - Data Formatting - Data Forwarding	- NISN -- IF Switching -- Data Formatting -- Data Forwarding - CTFS	- Generate DG1 Mode 2 signal using IFG - Switch IFG to multiple DMUs - Store recovered data - Provide recovered data to NISN emulator - DASCON commanding - Status Reporting and Collection - Provide UPD to SWSI

FAT is to be conducted in essentially the same manner as the testing that is being performed for System Qualification. These details were discussed previously in Section 2, which applied to all three phases of verification testing; specifically we recall:

- Section 2.7: Roles and Responsibilities for Test Execution
- Section 2.11: Test Runs
- Section 2.14: Reports.

The order and associated rationale in which these tests are conducted are provided below:

Exhibit 4.2-2: Tentative Test Order and Schedule For FAT

FAT Test Case Number	Title/Description	ROM Time Duration (hr)	Rationale for Test Sequence Order
F1	**Power-Up**	0.5	Clearly this is first step and thus is the first test
F2	**Customer Interactions**	2	This will allow the database to be set up to accommodate and appropriately process signal inputs in later tests
F3	**LCM Support**	2	This is similar to F4 and again allows for Database set up for signal inputs in later tests
F4	**Front-End Processing**	2	This occurs after the database has been set up (i.e., in F4, F5) to provide the right connectivity between the P/P EMC and the IBUs. The database also establishes the correct IBUG mode and direction cosine processing
F5	**Back-End Processing**	2	This occurs after the database has been set up (i.e., in F4, F5) to provide the right connectivity between the IFG and the DMUs. The database also establishes the correct DMU signal mode, Doppler processing and PTP data processing.

Section 4.4 later provides further insight into each FAT test, while Volume II of the DRL-11 (Acceptance Test Plans and Procedures) will ultimately document the step-by-step procedure for each FAT test. An evaluation of these FAT tests is first offered in Section 4.3.

4.3 FAT COMPLETENESS EVALUATION

The goal of the FAT is to exercise the principal functions and interfaces of DAS. Each individual test covers a subset of the functions and interfaces associated with this equipment. Tests can be invoked and monitored from the Front Panel Display (FPD) on the equipment as well as from the LCM GUIs on the DASCON, ICON and DASCON Workstations.

Since each individual test exercises a subset of the DAS functionality, it is important to look at the complete cross-section formed by the dimensions of test titles, interfaces, and functions in evaluating the extent of test coverage. Exhibit 4.3-1 shows this cross-section in terms of a traceability matrix. The information shown in the table visually portrays the degree of test coverage. An ‘X’ entry in the table indicates that the test sufficiently exercises the specific function or interface to be verified. When it is not possible to fully test a particular component within one single test, the symbol ‘P’ is used in the table to indicate *partial* verification. In this case, multiple partial verifications will fully demonstrate the item. Exhibit 4.3-1 shows that all of the major functions, external interfaces, and hardware chassis are exercised at least once during the course of the FAT testing. Note that only the tests allocated to verifying a particular functional component is indicated in the table, even though many of the components are actually exercised in several different tests.

Exhibit 4.3-1: DAS FAT Test Cases

1	2	3				
CI/Subsystem or External Interface	**Key Functional Requirements or External I/F to be verified for FAT**	**Mapping to FAT Tests**				
		F1	**F2**	**F3**	**F4**	**F5**
		Power Up	**Customer Interaction**	**LCM Support**	**Front End Processing**	**Back-End Processing**
EMC Interface CI	Power Up	**X**				
	BIST	**X**				
	Respond to Config Command				**X**	
	Provide Status	**P**			**P**	
	Provide FPD Functionality				**X**	
	Route EMC Signals				**X**	
	Route CDB				**X**	
IBUG CI	Power Up	**X**				
	BIST	**X**				
	Respond to Config Command			**P**	**P**	
	Provide Status	**P**		**P**	**P**	
	Provide FPD Functionality				**X**	
	Beamform				**X**	
	Support Multiple Modes				**X**	
IF Switch CI	Power Up	**X**				
	BIST	**X**				
	Respond to Config Command		**P**	**P**		**P**
	Provide Status	**P**	**P**	**P**		**P**
	Provide FPD Functionality					**X**
	Route IF Signals					**X**
DMG CI	Power Up	**X**				
	BIST	**X**				
	Respond to Config Command		**P**	**P**		**P**
	Provide Status	**P**	**P**	**P**		**P**
	Provide FPD Functionality					**X**
	Demodulate user Signals					**X**
DSER CI	Power Up	**X**				
	BIST	**X**				
	Respond to Config Command		**P**	**P**		**P**
	Provide Status	**P**	**P**	**P**		**P**
	Process/Format Data					**X**
	Forward data to Customers					**X**
DCON CI	Power Up	**X**				
	BIST	**X**				
	Receive DASCON Config Cmds		**P**	**P**		**P**
	Transmit Config Cmds to DMG		**P**	**P**		**P**
	Transmit Config Cmds to IF Switch		**P**	**P**		**P**
	Propagate User ephemeris					**X**
	Generate Doppler Correction					**X**
	Receive Status Data from equipment					**X**
	Forward Status Data to DASCON	**P**				**P**
ICON CI	Power Up	**X**				
	BIST	**X**				
	Receive DASCON Config Cmds		**P**	**P**	**P**	
	Transmit Config Cmds to DMG		**P**	**P**	**P**	
	Transmit Config Cmds to IF Switch		**P**	**P**	**P**	
	Propagate User ephemeris				**X**	
	Generate Doppler Correction				**X**	
	Receive Status Data from equipment				**X**	
	Forward Status Data to DASCON	**P**			**p**	

1	2	3				
CI/Subsystem or External Interface	Key Functional Requirements or External I/F to be verified for FAT	Mapping to FAT Tests				
		F1	F2	F3	F4	F5
		Power Up	Customer Interaction	LCM Support	Front End Processing	Back-End Processing
DASCON CI	Power Up	X				
	BIST	X				
	Support Customer Planning via SWSI		X			
	Support Customer Planning via LCM			X		
	Generate Config Cmds to DCON		P	P		P
	Generate Config Cmds to ICON		P	P	P	
	Generate Config Cmds to DSER		P	P		P
	Receive Status Data from ICON/DCON	P	P	P	P	P
	Provide UPD to Customers		P	P		P
	Support LCM for maintenance ops	P	P	P	P	P
Timing & Freq CI	Power Up: Freq Distribution Amplifier	P				
	BIST	X				
	Provide Status	P	P	P	P	P
	10 MHz Distribution		P	P		P
	Provide IRIG-G Conversion		P	P		P
	Provide IRIG-B Distribution		P	P		P
Power & Mechanical CI	Power Up	X				
	BIST	X				
External Interfaces	EMC				X	
	NISN		X			X
	SWSI		X			
	CTFS		X	X	X	X

4.4 FAT TEST - OBJECTIVES AND DESCRIPTION

This subsection provides a brief description and key objectives for each of the DAS five FAT tests. These tests are designed to take the DAS through a series of exercises to demonstrate high-level functionality and operational readiness prior to shipping and delivery to NASA.

4.4.1 Test Case F1 - Power-Up Test

Test Case F1 will demonstrate that all DAS hardware powers up correctly. The specific power-up sequence to be followed will be the one identified in the DAS O&M Manual. The DASCON will be powered first, so that it is available to receive status-reports as each additional hardware chassis is powered-up in turn. All LCM GUIs will be monitored and assessed.

Among other aspects, the test must show the following:

- All hardware and software BISTs are conducted as required
- All performance parameters are reported to DASCON as required
- The performance data indicates that all equipment are in their nominal initial state
- All chassis indicators are in their nominal initial state

4.4.2 Test Case F2 - Customer Interactions

Test Case F2 will demonstrate that the DASCON is properly supporting the SWSI interface and the processing associated with supporting Customer interactions relating to resource allocation. The Developmental SWSI will provide the signal stimuli into DAS, consisting of messages identified in the DAS/SWSI ICD. If the Developmental SWSI is unavailable, another option here is to use the DASCON LCM to initiate a Customer Service request.

Proper DASCON operation will be assessed by examining the LCM GUIs and the messages sent back by DASCON to SWSI. The test will include a sampling of the messages identified in the DAS/SWSI ICD that are received and sent by DASCON.

4.4.3 Test Case F3 - CM Support

Test Case F3 will demonstrate that the DASCON is properly supporting the DAS LCM function. All LCM GUIs will exercised; this includes DASCON, ICON and DCON GUIs. The test will ensure that at least one occurrence of every screen is exercised during the test.

Among other aspects, the test must show the following functionality:

- DASCON delogging
- Maintenance planning for IBUs and DMUs
- Performance and status monitoring
- Customer resource planning
- Database queries.

4.4.4 Test Case F4 - Front-End Processing

Test Case F4 will demonstrate that the EMC I/F Subsystem (Fiber Switch and CDB Switch) and the IBUGs are functioning properly. The P/P EMC will provide the signal stimuli into DAS, consisting of both Element Data (Fibre Channel) and Common Data Broadcast (ETHERNET). The EMC switching function will be exercised by changing both input and output configurations. The EMC will provide MA-Array CW signals, which allow for a reasonably good assessment of IBU functionality. This will be achieved by looking at the IBU output spectrum, power detection, and in-synch indicators. The Fibre Switch provides a straightforward way to generate multiple signal copies, so that all IBUs can be tested efficiently. IBUG FPD displays will also be exercised.

Among other aspects, the test must show the following:

- Both EMC I/F inputs and outputs can be configured
- The EMC I/F correctly routes Element Data and CDB data
- All IBUs are correctly processing the CW tone generated by the EMC
- All FPDs allow for configuration control

- All FPDs accurately report status and faults.

4.4.5 Test Case F5 - Back-End Processing

Test Case F5 will demonstrate that the DMG, PTPs and the Customer Data I/F (NISN) are functioning properly. The IFG will provide the signal stimuli into DAS, consisting of a DG1 Mode 2 signal with data. The IF Switch will be exercised by changing both input and output configurations. The IFG-provided signal allows for an excellent assessment of DMU functionality by its capability to generate DG1 Mode 2 signals over all data rates and configurations (except Unbalanced QPSK). Proper DMU operation will be assessed by examining the recovered data and receiver lock indicators. The IF Switch provides a straightforward way to generate multiple signal copies, so that all DMUs can be tested efficiently. DMG FPD displays will also be exercised. The recovered baseband data is provided by the DMG to the PTPs. The NISN emulator will be used to assess that data is sent in near real-time to Customers, as required.

Among other aspects, the test must show the following:

- Both IF Switch inputs and outputs can be configured
- The IF Switch correctly routes IF signals
- All DMUs are correctly processing the DG1 Mode 2 generated by the IFG
- The PTP correctly formats the data
- The PTP stores the recovered data
- The PTP passes the recovered data in near real-time to NISN I/F emulator
- All FPDs allow for configuration control
- All FPDs accurately report status and faults.

5. SAT PLAN (PHASE III VERIFICATION)

5.1 INTRODUCTION

5.1.1 Purpose

SAT Testing represents the third and final phase of formal DAS verification. The purpose of SAT is to verify that:

- The equipment has been packed, shipped and unpacked without damage
- The equipment has been re-assembled and integrated properly
- The system works with the actual operational interfaces
- The system works end-to-end in its operational configuration
- All previously 'conditionally' verified SRD requirements in System Qualification testing are fully verified.

The SAT Test plan provides the basis for testing the functionality of the DAS equipment in their operational configuration and connected to their operational interfaces. The SAT tests are designed to ensure high-level technical compliance with the DAS hardware and functional requirements prior to operations.

5.1.2 Scope

This SAT Test plan includes an overview of the specific tests to be conducted in terms of:

- Test identification
- Key functions to be demonstrated
- Key interfaces to be demonstrated
- The order of test execution.

5.2 TEST PLAN OVERVIEW

The DAS SAT testing will take place at WSGT and GRGT. The equipment being tested will initially consist of the three WSGT DAS racks and the three DAS GRGT racks, but will ultimately involve all external interfacing elements; these include: GDIS, SWSI, NISN, CTFS, CTFS SSC, WSC EMCs and WSC ECONs. SAT Testing is comprised of three phases (denoted as Phases A, B and C) that assess increasing levels of DAS integration in its intended operational environment:

- Phase A: '*Stand-Alone DAS*' Testing
  - Ensures DAS functionality prior to testing with elements external to DAS
  - Similar in the scope, objectives and methodology to that of FAT testing
  - Repeats aspects of FAT Test Cases F1, F3, F4 and F5

- Phase B: '*Conditional Re-Qualification'* Testing
  - Re-tests those requirements that were 'conditionally ' verified under System Qualification (Column 9 of Appendix A)
  - Verifies DAS functionality with external interfaces
  - Successively replaces the External I/F emulators used for System Qualification with actual Operational I/Fs
- Phase C: '*End-to-End System*' Testing
  - Verifies end-to-end functionality and performance using all operational elements of DAS
  - Provides the basis for the Operational Readiness Review.

With these considerations in mind, Exhibits 5.2-1 to 5.2-3 list the DAS tests that comprise SAT for Phases A (S1-S4), B (S5-S9) and C (S10), respectively.

Exhibit 5.2-1:DAS Test Cases for SAT Phase A: S1-S4 (Stand-Alone DAS Testing)

1	2	3	4	5
SAT Test Case #/ Title **(Previous Test Case Reference)**	**Test Overview**	**Key Aspects to be Demonstrated**	**Success Criteria**	**Comments**
S1 **Power-Up** **(F1)**	・Connect DAS equipment to GDIS ・Power up all WSGT Equipment ・Monitor WSGT Equipment ・Power up all GRGT Equipment ・Monitor GRGT Equipment ・Connect Emulators	・Equipment operated nominally in initial unallocated state ・DAS/GDIS I/F	・All equipment (at WSGT and GRGT) powers up successfully and reports correct status to DASCON	・Similar to FAT F1 but S1 will use GDIS to establish the DASCON C&S I/F rather than the GDIS Emulator ・S1 will first verify DASCON C&S I/F among WSGT elements before testing GRGT equipment
S2 **LCM Support** **(F3)**	・Request service ・Send resource availability data ・Initiate Service ・DASCON commanding ・Status Reporting and Collection ・Request delog ・Set up maintenance event	・Operator/LCM ・Control of GRGT equipment over the GDIS	・Equipment is appropriately allocated to support Customer services and Maintenance actions	・Allows database to be set up for signal processing testing in S3 and S4 ・Ensures that DASCON can control equipment both at WSGT and GRGT

1	2	3	4	5
SAT Test Case #/ Title **(Previous Test Case Reference)**	**Test Overview**	**Key Aspects to be Demonstrated**	**Success Criteria**	**Comments**
S3 Front-End Processing **(F4)**	Part 1: P/P EMC ・Generate CW Tone using P/P EMC ・Switch EMC output to multiple IBUs ・DASCON commanding ・Status Reporting and Collection Part 2: Actual EMC interfaces ・Replace P/P EMC with actual WSC EMC I/F	・EMC I/F Switching ・Proper operation of all IBUs	・EMC Switching is performed as commanded ・ALL IBUs properly process the CW Test Tone	・S3 first uses the P/P EMC and Factory ECON to replicate the FAT environment which allows focus first on the DAS elements rather than on external I/Fs (Part 1 may be omitted if shipping the extra equipment is deemed unnecessary) ・At GRGT, S3 will need to use the GRGT EMC at this point (note that the GRGT I/F is not as complex as that at WSGT)
S4 Back-End Processing **(F5)**	Part 1: CTFS Emulator ・Generate DG1 Mode 2 signal using IFG ・Switch IFG to multiple DMUs ・Store recovered data ・Provide recovered data to NISN emulator Part 2: WSC CTFS ・Connect CTFS	・IF Switching ・ Proper operation of all DMUs ・Proper Operation of PTPs	・IF Switching is performed as commanded ・ALL DMUs properly process the IFG Test Signal ・ALL PTPs properly process the recovered IFG Test Signal	・At GRGT, there will not be an IFG so this testing may be delayed until a simulation test is run in a later SAT Test ・Part 2 will verify the WSC CTFS which will be used in all succeeding testing

Exhibit 5.2-2: DAS Test Cases for SAT Phase B: S5-S8 ('Conditional' Retesting)

1	2	3	4	5
SAT Test Case #/ Title **(Previous Test Case Reference)**	**Test Overview**	**Key Aspects to be Demonstrated**	**Success Criteria**	**Comments**
S5 CTFS SSC Alert I/F **(Q8)**	・DASCON is connected to the CTFS SSC ・Essentially repeats much of Q8 relative to the requirements in Column 4 of this table	・All those requirements under Q8 noted as 'C' in Column 9 of the VPT (Appendix A)	・The corresponding Success Criteria in Column 8 of the VPT (Appendix A)	・Re-Qualification using operational CTFS SSC I/F
S6 Customer Interactions via SWSI **(Q1)**	・DAS is connected to NISN for the SWSI ・SWSI will exercise all message types consistent with DAS/SWSI I/F ・Essentially repeats much of Q1 relative to the requirements in Column 4 of this table	・All those requirements under Q1 noted as 'C' in Column 9 of the VPT for(Appendix A)	・The corresponding Success Criteria in Column 8 of the VPT (Appendix A)	・Re-Qualification using operational SWSI I/F

1	2	3	4	5
SAT Test Case #/ Title **(Previous Test Case Reference)**	**Test Overview**	**Key Aspects to be Demonstrated**	**Success Criteria**	**Comments**
S7 Customer Data via NISN **(Q6)**	・DAS is connected to NISN for Data ・SWSI will use to initiate service ・Will use data in the PTPs obtained under S4 to exercise the Customer data I/F via NISN ・Essentially repeats much of Q6 relative to the requirements in Column 4 of this table	・All those requirements under Q6 noted as 'C' in Column 9 of the VPT (Appendix A)	・The corresponding Success Criteria in Column 8 of the VPT (Appendix A)	・Re-Qualification using operational NISN Data I/F
S8 Full-up DAS Testing **(Q4)**	・DASCON is connected to the WSC and GRGT ECONs ・DASCON is connected to the CTFS SSC ・Essentially repeats much of Q4 relative to the requirements in Column 4 of this table	・All those requirements under Q4 noted as 'C' in Column 9 of the VPT (Appendix A)	・The corresponding Success Criteria in Column 8 of the VPT (Appendix A)	・Re-Qualification using all operational interfaces

Exhibit 5.2-3: DAS Test Case for SAT Phase C: S9 (End-to-End Demo)

2	3	4	5	6
SAT Test Case #/ Title **(Previous Test Case Reference)**	**Test Overview**	**Key Aspects to be Demonstrated**	**Success Criteria**	**Comments**
S9 EET Demo 1	・Shadow Testing and Data Recovery of actual LEO User ・DAS will recover a MA User DG1, Mode 2 signal ・DAS will be provided User configuration parameters and State Vector 1 day in advance to service start ・If possible user reconfiguration event will occur during service ・Playback of data will also be requested	・Service Planning ・Resource allocation ・Beamforming ・Demodulation ・Data forwarding and storage ・User performance parameters ・Logging/delogging	・Correct Data Recovered and provided to customer ・Service performance parameters reported during service ・Proper logging of the event	・This needs to be coordinated in advance with WSC personnel to determine the options and select the most appropriate user service for shadowing

SAT is to be conducted in essentially the same manner as the testing that is being performed for System Qualification. These details were discussed previously in Section 2, which applied to all three phases of verification testing; specifically we recall:

- Section 2.7: Roles and Responsibilities for Test Execution

- Section 2.11: Test Runs
- Section 2.14: Reports.

SAT Testing will take place in the '2/12/02 to 3/29/02' timeframe, as indicated previously in the high-level schedule of Exhibit 2.9-1. The order and timeframe in which these tests are conducted are provided below:

Exhibit 5.2-2: Tentative Test Schedule For SAT

SAT Test Phase	SAT Test Case Number	Title/Description	Tentative Timeframe	ROM Time Duration (hours)
Phase A: Stand-Alone DAS Testing	**S1**	**Power-Up**	End-of February	3
	S2	**LCM Support**	End-of February	3
	S3	**Front-End Processing**	End-of February	4
	S4	**Back-End Processing**	End-of February	4
Phase B: 'Conditional' Re-Qualification Testing	**S5**	**CTFS SSC Alert I/F**	Beginning of March 2002	4
	S6	**Customer Interactions via SWSI**	Beginning of March 2002	16
	S7	**Customer Data via NISN**	Beginning of March 2002	8
	S8	**Full-up DAS Testing**	Beginning of March 2002	16
Phase C: End-to-End System Testing (EET)	**S9**	**EET Demo 1**	Middle of March 2002	8

Section 5.3 below provides further insight into each SAT test, while Volume II of the DRL-11 (Acceptance Test Plans and Procedures) will ultimately document the step-by-step procedure for each SAT test.

5.3 SAT TEST - OBJECTIVES AND DESCRIPTION

This subsection provides a brief description and key objectives for each of the DAS SAT tests. These tests are designed to take the DAS through a series of exercises to demonstrate high-level functionality and operational readiness prior to the DAS Operational Readiness Review (ORR) scheduled for Spring

of 2002. Ongoing coordination between the WSGT and GRGT test personnel is required essentially through all of SAT. The main control element of the DAS equipment is the DASCON, which resides at WSGT only.

5.3.1 Test Case S1 - Power-Up Test

This test will demonstrate that all DAS hardware powers up correctly and reports status as expected. The specific power-up sequence to be followed will be the one identified in the DAS O&M Manual. The DASCON will be powered first, so that it is available to receive status-reports as each additional hardware chassis is powered-up in turn. All LCM GUIs will be monitored and assessed. Note that the equipment at GRGT will be powered up only after this test has been successfully completed for the WSGT equipment suite.

Among other aspects, the test must show the following:

- All hardware and software BISTs are conducted as required
- All performance parameters are reported to DASCON as required
- The performance data indicates that all equipment are in their nominal initial state
- All chassis indicators are in their nominal initial state
- GRGT equipment is reporting to DASCON in exactly the same manner as their counterparts at WSGT.

5.3.2 Test Case S2 - LCM Support

This test will demonstrate that the DASCON is properly supporting the DAS LCM function and permits Customer services to be requested that will support signal processing testing in SAT test S3 and S4 that follow. The test will also demonstrate that DASCON at WSGT can control and configure GRGT equipment via the GDIS. All LCM GUIs will be exercised; this includes DASCON, ICON and DCON GUIs. The test will ensure that at least one occurrence of every screen is exercised during the test, which would also permit verification that all equipment is functioning nominally. Note that the GRGT LCM GUIs will also be exercised by test personnel at GRGT.

Among other aspects, the test must show the following functionality:

- LCM delogging (including printing)
- Maintenance planning for IBUs and DMUs (Items can be made ‘unavailable’ due to maintenance planning)
- Performance and status monitoring (including those parameters from the GRGT equipment relayed via GDIS)
- Control of GRGT equipment via GDIS
- Database supports a wide range of queries.

5.3.3 Test Case S3 - Front-End Processing

This test will demonstrate that the EMC I/F Subsystem (Fiber Switch and CDB Switch) and the IBUGs are functioning properly. The P/P EMC will provide the signal stimuli into DAS, consisting of both Element Data (Fibre Channel) and Common Data Broadcast (ETHERNET). The EMC switching function will be exercised by changing input-to-output port configurations. The EMC will provide MA-Array CW signals, which allow for a reasonably good assessment of IBU functionality. This will be achieved by looking at the IBU output spectrum, power detection, and in-synch indicators. The Fibre Switch provides a straightforward way to generate multiple signal copies, so that all IBUs can be tested efficiently. IBUG FPD displays will also be exercised.

Among other aspects, the test must show the following:

- Both EMC I/F inputs and outputs can be configured
- The EMC I/F correctly routes Element Data and CDB data
- All IBUs are correctly processing the CW tone generated by the EMC
- All FPDs allow for configuration control
- All FPDs accurately report status and faults.

5.3.4 Test Case S4 - Back-End Processing

This test will demonstrate that the DMG, PTPs and the Customer Data I/F (NISN) are functioning properly. The IFG will provide the signal stimuli into DAS, consisting of a DG1 Mode 2 signal with data. The IF Switch will be exercised by changing both input and output configurations. The IFG-provided signal allows for an excellent assessment of DMU functionality by its capability to generate DG1 Mode 2 signals over all data rates and configurations (except Unbalanced QPSK). Proper DMU operation will be assessed by examining the recovered data and receiver lock status indicators. The IF Switch provides a straightforward way to generate multiple signal copies, so that all DMUs can be tested efficiently. DMG FPD displays will also be exercised. The recovered baseband data is provided by the DMG to the PTPs. The NISN emulator will be used to assess that data is sent in near real-time Customers, as required.

Among other aspects, the test must show the following:

- Both IF Switch inputs and outputs can be configured
- The IF Switch correctly routes IF signals
- All DMUs are correctly processing the DG1 Mode 2 generated by the IFG
- The PTP correctly formats the data
- The PTP stores the recovered data
- The PTP passes the recovered data in near real-time to NISN I/F emulator
- All FPDs allow for configuration control

- All FPDs accurately report status and faults.

5.3.5 Test Case S5 - CTFS SSC Alert I/F

After the somewhat 'stand alone' DAS testing in the previous tests, Test Case S5 begins the process of connecting DAS to the actual operational interfaces one-by-one. The objective of Test Case S5 is to verify the DASCON Alert I/F with the CTFS SSC. In Test Case S5, DASCON will send alerts to the CTFS SSC. Test Case S5 is similar to Qual Test Case Q8, whose test approach and success criteria are provided in Appendix A. Among other items, Test Case Q8 must demonstrate that DAS sends alerts to the CTFS SSC as specified in the DAS SRD Paragraph 3.1.7.1.f.

5.3.6 Test Case S6 - DASCON/Customer Interactions Using SWSI

The objective of Test Case S6 is to verify that via the actual SWSI Interface, DAS supports customer interactions for scheduling, and that DAS provides service status and performance data to customers. The requirements assigned a 'C' in Column 9 of Appendix A under Qual Test Case Q1 are the focus of Test Case S6. Thus, Test Case S6 is similar to Qual Test Case Q1, whose test approach and success criteria are provided in Appendix A.

In Test Case S6, DAS is connected via the NISN open IO network to the operational SWSI. Both systems will be demonstrating the capabilities to exchange messages as described. Using the Controller displays, the test personnel will issue commands to the DSER and DASCON and monitor the resultant status on the Controller displays and the front panels of the DSER and DASCON. Time tags displayed in the Controller logs will be used to determine status update rate.

The IFG will be used to generate user signals that can be recovered by the DMUs, processed by the PTPs and provided to the NISN Customer emulator. The SWSI I/F will be monitored to demonstrate that UPD data is provided to the customer, as requested, during data demodulation and recovery.

Among other items, Test Case S6 must demonstrate the following:

- DAS and DASCON provide Customer with the capability of entering, storing, updating and retrieving constant parameters that are included routinely in requests for resource allocations.
- DAS automatically retrieves and attaches information to a resource allocation request and reports performance and status data when requested.
- DAS collects and reports performance status for all DAS Customer services
- DAS properly interfaces with the SWSI Interface in accordance with the SWSI ICD.

5.3.7 Test Case S7 – Customer Data I/F (NISN)

The objective of Test Case S7 is to verify that DAS supports the provision of Customer Data via the actual operational NISN I/F. The requirements assigned a 'C' in Column 9 of Appendix A under Qual

Test Case Q6 are the focus of Test Case S7. Thus, Test Case S7 is similar to Qual Test Case Q6, whose test approach and success criteria are provided in Appendix A.

In Test Case S7, the NISN will be used with DSER to demonstrate the requirements associated with return data handling and provision of this data to Customers. The IFG and DMG are used to generate the data for transfer via NISN.

Among other items, Test Case S7 must demonstrate the following:

- DAS provides the capability to route MA return data distribution, archiving and retrieving capabilities.
- DAS provides the capability to route return data obtained in near real-time or retrieved from the archive.
- DAS retrieves the designated MA return data from archive at the times specified in DAS Customer requests for resource allocations.
- DAS transmits MA telemetry data to DAS Customer destinations based on routing information.
- DAS automatically manages the storage and removal of archived return data.
- DAS archives the return data and logs the archiving event in the DAS Customer service accounting data if designated to do so in the DAS Customer request specifications.
- DAS automatically removes data that has exceeded its specified lifetime limit from the return data archive.

5.3.8 Test Case S8 - Comprehensive DAS Functional Testing

The objective of Test Case S8 is to verify a wide range of DAS functionality relating to status monitoring, resource allocation requirements, Customer support, and maintenance. The requirements assigned a 'C' in Column 9 of Appendix A under Qual Test Case Q4 are the focus of Test Case S8. Thus, Test Case S8 is similar to Qual Test Case Q4, whose test approach and success criteria are provided in Appendix A.

In Test Case S8, the DASCON interfaces with ECON, DSER, ICON and DCON will be tested. The actual WSC ECONs will provide TDRS SVs to verify proper vector management of TDRS SVs. Among other items, Test Case S8 must demonstrate the following:

- DAS collects and reports system wide status of the hardware and software components that constitute the DAS.
- DAS collects and reports performance status and service accounting for Customer services.
- DAS provides Customers with MA return data processing, formatting, distribution, archiving and retrieving capabilities.
- DAS provides local control and monitoring interface to the DAS.

- DAS provides for automated startup and shutdown control of the DAS, addition and removal from the shared pool of resources and modify the DAS Customer identification data.
- DASCON, DCON and ICON control and monitor the DAS equipment
- DAS automatically manages TDRS and DAS Customer vector data including ephemeris generation, storage and removal using state vectors
- DAS automatically generates DAS Customer emitter ephemeris from DAS Customer supplied emitter Type 1 (on-orbit) and Type 8 (stationary) state vectors.

5.3.9 Test Case S9 – End-to-End Demo 1

The objective of Test Case S9 is to demonstrate that DAS works all its external interfaces and meets all critical functionality, performance and operational requirements. In Test Case S9, an End-to-End demo is to be conducted that will demonstrate all operational aspects of DAS; these will include:

- DAS support of Customer planning:
  - Adding new Customers to DAS Database
  - Responding to SWSI request for service
  - Planning and allocating DAS resources
  - Reporting of DAS Service Visibility Legs
  - Adding/deleting service requests
- DAS support of active Customer services:
  - Beamforming
  - Demodulation
  - Data formatting
  - Data archiving
  - Data routing (to Customer Local Interfaces and destinations through the NISN IOnet)
  - Data playback
  - Performance status reporting
  - Support to request for service modification
- DAS support of O&M:
  - Responding to planned maintenance activities and requests
  - Delogging
  - Generating Extended Reports
  - Generating Database Reports
  - Generating Service Accounting Reports
  - Fault monitoring and reporting
  - Adding/removing resources (DMUs and IBUs)
  - Supporting Operator LCM inputs and control
  - Providing FPDs and keypads for operator control and monitoring.

In order to realistically demonstrate the DAS ability to support orbiting Customer platforms, it will be necessary to 'shadow-test' one or more existing MA LEO users. The simulation capability at WSC via a TDRS uses a fixed antenna at the ground terminal, and thus does not readily support the simulation of orbiting users. It will also be necessary to set up a 'Customer Destination' host that can receive IP recovered data that is routed via NISN.

In accordance with the items noted above, the demo will include the following:

- Add at least two Customers to the DAS Database
- Have SWSI request services for these Customers
- DAS will then perform the appropriate planning
- The demo will check that the Visibility Service Legs are regenerated correctly
- Prior to the start of service, several actions will be taken and the subsequent response by DAS monitored; these include:
  - Remove IBUs, DMUs
  - Submit new Customer and TDRS State Vectors
  - Request modifications to existing service requests
- During actual support of scheduled service time, the demo will:
  - Monitor SWSI and LCM screens to verify that parameters and performance status data are properly displayed
  - Request modification of user parameters
- DAS will be monitored to ensure that the following processing is being performed correctly:
  - Beamforming
  - Demodulation
  - Data formatting
  - Data archiving
  - Data routing
  - Data playback
  - Performance status reporting
  - Parameter modification
- During the demo the LCM GUIs will be exercised to execute, monitor and assess:
  - Planned maintenance
  - Delogging
  - Extended reports
  - Database Reporting
  - Fault monitoring and reporting
  - Adding/removing resources (DMUs and IBUs)
  - Operator LCM inputs and control
  - FPDs.

APPENDIX A: VERIFICATION PLANNING TABLE (VPT)

Provided under separate cover.

APPENDIX B: ACQ/BER QUALIFICATION TEST RUNS

B.1 BER TEST RUNS FOR QUALIFICATION TESTING (Q3 AND Q9)

The DMU will undergo detailed BER testing using the IFG at the DAS Factory (Q3) and the simulation capabilities at WSGT (Q9). Due to the limitations of the IFG test equipment, the testing at WSGT focuses on signal Doppler and I/Q Power Imbalance.

Exhibit B-1: BER Test Runs

BER Case No.	Test Parameters													Test Measurements		Qual Test Case
				Data Rate Performance*			Data Rate Functional*			I/Q Power Ratio						
	Data Modulation - Data Channels	Symbol Format	Data Format	1 K	10 K	100 K	50 K	128 K	150 K	Balanced	Unbalanced (at WSGT) *	With Doppler (at WSGT)	G2 Inv	PN Code	Ambiguity Resolution	BER	
1, 2	BPSK	NRZ	NRZ-L	X			X						X	1		X	Q3
3, 4	BPSK	NRZ	NRZ-M		X			X						2	X	X	Q3
5, 6	BPSK	NRZ	NRZ-S			X			X				X	3	X	X	Q3
7, 8	BPSK	Bi-φ	NRZ-L		X			X						4		X	Q3
9,10	BPSK	Bi-φ	NRZ-M			X			X					1	X	X	Q3
11, 12	BPSK	Bi-φ	NRZ-S	X			X							2	X	X	Q3
13, 14	BPSK	NRZ	NRZ-L	X					X			X	X	3		X	Q9
15, 16	BPSK	Bi-φ	NRZ-M			X		X				X		4	X	X	Q9
17, 18	QPSK-1	NRZ	NRZ-L		X			X		X			X	4		X	Q3
19, 20	QPSK-1	NRZ	NRZ-M			X			X	X				3	X	X	Q3
21, 22	QPSK-1	NRZ	NRZ-S	X			X			X				2	X	X	Q3
22, 24	QPSK-1	Bi-φ	NRZ-L			X			X	X				1		X	Q3
25, 26	QPSK-1	Bi-φ	NRZ-M	X			X			X				4	X	X	Q3
27, 28	QPSK-1	Bi-φ	NRZ-S		X			X		X				3	X	X	Q3
29, 30	QPSK-1	NRZ	NRZ-L		X			X			X	X	X	2		X	Q9
31, 32	QPSK-1	Bi-φ	NRZ-M	X			X				X	X		1	X	X	Q9
33, 34	QPSK-2	NRZ	NRZ-L	X			X			X				1		X	Q3
35, 36	QPSK-2	NRZ	NRZ-M		X			X		X			X	2	X	X	Q3
37, 38	QPSK-2	NRZ	NRZ-S			X			X	X				3	X	X	Q3
39, 40	QPSK-2	Bi-φ	NRZ-L		X			X		X				4		X	Q3
41, 42	QPSK-2	Bi-φ	NRZ-M			X			X	X				1	X	X	Q3
43, 44	QPSK-2	Bi-φ	NRZ-S	X			X			X				2	X	X	Q3
45, 46	QPSK-2	NRZ	NRZ-L	X			X				X	X	X	3		X	Q9
47, 48	QPSK-2	Bi-φ	NRZ-M			X		X			X	X		4	X	X	Q9

Notes:

1. Detailed BER performance runs will be conducted for data rates of 1, 10 and 100 kbps (as per the SRD) involving very long data sequences to achieve high confidence levels. Functional

verification will be conducted for data rates of 50, 128, and 150 kbps involving shorter sequences to demonstrate that the receiver supports these rates.

2. For unbalanced I:Q power ratio tests, the corresponding I and Q data rates will be adjusted according to this imbalance as well.
3. Unbalanced I:Q ratio testing and Doppler testing will be conducted at WSGT
4. QPSK-1 refers to single data channel operation; QPSK-2 refers to dual data channel operation.

B.2 ACQ TEST RUNS FOR QUALIFICATION TESTING (Q3 AND Q9)

The DMU will undergo detailed ACQ testing using the IFG at the DAS Factory (Q3) and the simulation capabilities at WSGT (Q9). For the BER testing noted in Appendix B.1, a test consists of sending a very long data sequence and monitoring bit errors. On the other hand for acquisition testing, many relatively short data sequences will be sent that are long enough to accomplish acquisition (~ 1-3 seconds). For each new trial, the carrier frequency will be varied randomly over the respective frequency uncertainties for Modes A and B.

The target Acquisition Probability requirement is 90%. A sufficient number of trials will be conducted to achieve a high level of confidence. For example, the exhibit below illustrates for 2000 trials that under the worst case, the acquisition result (i.e., sample mean) is in error less than 2% with 99% confidence.

Exhibit B-2: Illustrative Confidence Results for Acquisition Testing

C1	C2	C3	C4	C5	C6	C7	C8	C9
Trials	Number of Misses	Number of Successes	Sample Mean (Target) (M)	99% Confidence Interval		Max Deviation from Target (= C4-C6)	% Error (=C7/C4)	% Error Bound
				Lower Prob P1	Higher Prob P2			
1000	100	900	0.9	0.92207	0.87793	0.02207	2.45182	< 3% Error
2000	200	1800	0.9	0.91560	0.88440	0.01560	1.73370	< 2% Error
3000	300	2700	0.9	0.91274	0.88726	0.01274	1.41556	< 2% Error
4000	400	3600	0.9	0.91103	0.88897	0.01103	1.22591	< 2% Error
5000	500	4500	0.9	0.90987	0.89013	0.00987	1.09649	< 2% Error
10000	1000	9000	0.9	0.90698	0.89302	0.00698	0.77533	< 1% Error

For BER, Eb/No is the driving parameter. However, for Acquisition C/No is the key driver, which means that the required acquisition performance is more difficult to achieve at the lower data rates. Also, acquisition is not sensitive to data formatting (NRZ- L, M, or S) or to G2 inversion as long as the stated transition density is achieved. Biphase symbol formatting does not affect PN and Carrier acquisition, but does help in transitioning to fine tracking as a result of the '*Data Transition Tracking Loop (DTTL)*' employed in the DAS DMU. With these considerations in mind, Exhibit B-3 identifies the acquisition cases to be tested.

Exhibit B-3: Acquisition Test Runs

Acq Case No.	Test Parameters										Test Measurements				Qual Test Case
	Data Modulation - Data Channels	Mode A or B	Symbol Format	Data Rate				I/Q Power Ratio		With Doppler (at WSGT)	# of Trials	Acq Time	Number of Success	Empirical Pacq	
				1 K	10 K	100 K	150 K	Balanced	Unbalanced (at WSGT) *						
1, 2	BPSK	A	NRZ	X	X										Q3
3, 4	BPSK	A	Bi-φ	X			X								Q3
5, 6	BPSK	B	NRZ	X		X									Q3
7, 8	BPSK	B	Bi-φ	X	X										Q3
9,10	BPSK	A	NRZ	X		X				X					Q9
11, 12	BPSK	B	Bi-φ	X	X					X					Q9
13, 14	QPSK-1	A	NRZ	X		X		X							Q3
15, 16	QPSK-1	A	Bi-φ	X	X			X							Q3
17, 18	QPSK-1	B	NRZ	X	X			X							Q3
19, 20	QPSK-1	B	Bi-φ	X			X	X							Q3
21, 22	QPSK-1	A	NRZ	X	X				X	X					Q9
22, 24	QPSK-1	B	Bi-φ	X		X			X	X					Q9
25, 26	QPSK-2	A	NRZ	X	X			X							Q3
27, 28	QPSK-2	A	Bi-φ	X			X	X							Q3
29, 30	QPSK-2	B	NRZ	X		X		X							Q3
31, 32	QPSK-2	B	Bi-φ	X	X			X							Q3
33, 34	QPSK-2	A	NRZ	X		X			X	X					Q9
35, 36	QPSK-2	B	Bi-φ	X	X				X	X					Q9

ABBREVIATIONS AND ACRONYMS

ADPE	Automatic Data Processing Equipment
AES	Advanced Engineering and Sciences
A&I	Analysis and Inspection (Report)
BER	Bit Error Rate
BIT	Built-in Test
CAR	Corrective Action Request
CCA	Circuit Card Assembly
CDB	Common Data Broadcast
CI	Critical Item
CM	Configuration Management
COTS	Commercial Off-the-Shelf
CPU	Central Processing Unit
C&S	Clock and Synchronization
CSI	Communications Systems Integration
CTFS	Central Time and Frequency Subsystem
DAS	Demand Access System
DCON	DMG Controller
DMG	Demodulator Unit Group
DMU	Demodulator Unit
ECF	Engineering Change Form
ECON	EMC Controller
EET	End-to End Test
EMC	Element Multiplexer/Correlator
EMI	Electromagnetic Interference
FAT	Factory Acceptance Test
FPD	Front Panel Display
FUF	Full-up Factory (DAS)
FW	Firmware
GDIS	GRGT Data Interface System
GSFC	Goddard Space Flight Center
GRGT	Guam Remote Ground Terminal
GUI	Graphical User Interface
HW	Hardware
IBU	Independent Beamforming Unit
IBUG	IBU Group
ICON	IBUG Controller
IF	Intermediate Frequency

IM&TE	Inspection, Measuring, and Test Equipment
IOnet	IP Operational Network
IR	Integrated Receiver
I&T	Integration and Test
ITT	ITT Industries Inc.
LAN	Local Area Network
LCM	Local Control Monitor.
LED	Light Emitting Diode
MA	Multiple Access
MABE	Multiple Access Beamforming Equipment
MHz	Megahertz
MSR	Monthly Status Review
NASA	National Aeronautics and Space Administration
NISN	NASA Integrated Services Network
O&M	Operations and Maintenance
P/P	Pre-Production
PVM	Performance Verification Matrix
QA	Quality Assurance
RAM	Random Access Memory
SAT	Site Acceptance Test
SCCB	Software Configuration Control Board
SGLT	Space-to Ground Link Terminal
SHO	Schedule Order
SPR	Software Problem Report
SRD	Systems Requirement Document
SSC	Subsystem Controller
STGT	Second TDRSS Ground Terminal
SYNCH	Synchronization
SW	Software
SWSI	Space Network Web-based Services Interface
TDP	Technical Data Package
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TGBFS	Third-Generation Beamforming Subsystem
TRR	Test Readiness Review
UUT	Unit Under Test
VPT	Verification Planning Table
WSC	White Sands Complex
WSGT	White Sands Ground Terminal